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ELECTRIC TRACTION INTO NEW YORK.

One of the most momentous decisions affecting the future of heavy electric traction was that made by the New York Central Railroad when it adopted direct-current locomotives for its through business in the electric zone and multiple-unit for its suburban traffic. This enabled it at once to secure maximum dispatch and economy in handling train service and passengers, and the extreme of minimization as to the dead movement of locomotives and cars. As a corollary came the double decking of the immense new Grand Central Depot, involving, as we understand, the operation of the locomotives on one tier and the multiple-unit suburban cars on the lower deck. This work of the Electric Traction Commission of the New York Central Railroad has indeed carried us far into the heart of the new regime, with incalculable benefits promised to every passenger, and one cannot but wish brilliant success and full fruition for such courageous plans and decisions. Second only in importance, it seems to us, in its bearing on the electric railway future, has been the recent decision of the New York, New Haven & Hartford Railroad to adopt electricity also, but to employ alternating-current apparatus. We have been swift to applaud this exhibition of faith in the newer type of apparatus and current, which seem destined in the long run to bring the solution of many problems hitherto beyond the capacity of the electrical arts; and it can be safely said that perhaps the performance of no single piece of apparatus will be watched more intently at the present juncture by electrical engineers than the single-phase locomotive now under construction and soon to be under test as the initial equipment. At this stage, however, a situation arises which it is difficult for an outsider to formulate definitely, but the character of which can be fairly well determined from the trenchant communication of Mr. Frank J. Sprague appearing elsewhere in our pages.

The situation as thus defined by Mr. Sprague involves the tremendous—perhaps insuperable—difficulties of operating the two types of apparatus within the New York Central electric zone, and more particularly the serious troubles predicated upon any attempt to operate the direct-current multiple-unit suburban trains of the Central in conjunction with the alternating-current locomotives of the New Haven on the lower tier of the splendid new terminal depot, upon which so many millions of dollars are now being spent with the essential underlying purpose of securing the utmost comfort and convenience of the traveling public, with due regard to the economy and efficiency of operation that must be the keynotes of every great railway system. Awaiting further light on the subject, which certainly must be forthcoming, we should hesitate to say that the difficult problems thus brought to light are incapable of harmonious solution, but the vivid discussion of the subject by Mr. Sprague, as is usual with all his treatment of great questions, strikes at the roots of the question, and while compelling to prayerful consideration begets as to decision a hesitancy that only a further flood of light can remove from one's mind.

EUROPEAN SINGLE-PHASE RAILWAYS.

In our issue for September 23 was given an account of the single-phase railways now operating in this country. On page 696 of our present issue we supplement that account with a brief outline description of the single-phase railways of Europe. In comparing the various equipments now installed, one is impressed with the fact

that the frequency adopted in Europe varies from 17 to 42 cycles, while in this country 25 cycles is used exclusively. There can be no doubt that the lower the frequency the better the commutation and the higher the power factor with the compensated-series type of motor; and that where the frequency can be selected without any regard to the use of the output from the power station for any purpose other than the motors themselves, the adoption of a frequency as low as 17 cycles, as first proposed by Mr. Lamme, is to be desired. For the operation of electric lamps a frequency as high as 40 cycles is desirable, and a frequency higher than 25 cycles is necessary for general illumination. To the fact that the motors are required to use current from the same source of supply of electric power as the lamps may be attributed the adoption of the higher range of frequency on the Stubai Valley and Du Borinage-Vicinaux Railways. It would seem, however, that the cases in which the electric railway must receive its power from an electric lighting plant will be exceptional and not general, and that for the sake of uniformity a frequency corresponding to that of motor circuits rather than of lamp circuits is in many respects preferable. It is significant that between the two extreme frequencies—that best suited for use exclusively with commutator motors and that best adapted for combined lighting and railway work—there has been found a satisfactory mean frequency suitable alike for general power distribution, for stationary motor work, and for the operation of alternating-current railways.

An encouraging feature of the numerous single-phase railways now in operation resides in the fact that the anticipated troubles at the commutators of the various types of motors with almost no exception have failed to appear. Difficulties have arisen on almost all of the railways, and the motors have contributed their share, but the troubles have been due more to faulty insulation or to too economical design than to any inherent defect in the motors themselves. For high-frequency current, such as demanded by certain kinds of lamps, the compensated-series type of motor seems not to be well adapted; but the transformer motors of the compensated-repulsion type appear to operate quite satisfactorily with such current and not to be exceptionally well adapted for current at the extremely low frequencies. At first glance it would appear that for combined direct-current and alternating-current operation the series type of motor possesses some marked advantages over the transformer type of machine. It is worthy of note, however, that the transformer motors have recently been operated satisfactorily when fed with direct current, a compensating winding being used for the purpose of counterbalancing the armature magnetomotive force. The evidence at hand would seem to indicate that not one of the types of commutator motors which have been seriously proposed for alternating-current railway work will need to be abandoned or materially modified to overcome any inherent defect, and that with the logical frequency of 25 cycles, which has been selected as standard for this country, and is gaining favor as a standard in Europe, excellent results can be obtained from either the compensated-series or the compensated-repulsion motors.

ILLUMINATING ENGINEERING.

Mr. Cravath's paper which we abstract elsewhere gives an effective answer to any question that might be urged as to the propriety of raising scientific illumination to the rank of a special branch of engineering. Considering the fact that electric lighting, to say nothing of other forms of illumination, is intrinsically a technical art and that the aggregate sum spent yearly, with central stations alone, for such light has now reached something like $70,000,000, it ought to be sufficiently obvious that technical advice as to the best methods of utilizing electric light is of the utmost importance. As a matter of fact, we know of no branch of business in which so large a sum total is expended with so little intelligent direction. Buildings are usually designed with scant reference to the lighting system. Every one assumes tacitly that wiring can be put anywhere and the most that the ordinary architect concedes to the necessities of the case is a meagre allowance of distributing ducts arranged frequently without any technical advice and often so placed as to guarantee inefficient distribution. The outlets in the rooms are insufficient in number and badly arranged at that; and even in large public buildings in which much care and thought should be given to lighting the results are often almost ingeniously bad. The Auditorium Theatre of which Mr. Cravath gave a picture, while in itself one of the most commodious buildings in the world and possessed of exceptionally good acoustic properties, is lighted so as to give a maximum of glare with a minimum of useful illumination. Illumination is a thing by which to see and not merely an artistic accessory or a subject for accidental consideration. In so far as light is a commodity for which good money has to be paid it behooves the user not to waste it, and in so far as it is a necessity of modern life it should be so used as to produce helpful, not hurtful, results. It is a good thing to realize that at the present time probably not less than $20,000,000 worth of light is wasted annually by unskillful use. To save this dead loss to the community is the task which the illuminating engineer has undertaken to accomplish. The difficulty is that the profession has as yet no well-recognized position. The average architect thinks himself quite capable, however guiltless he may be of electrical knowledge, of planning the lighting of any building on earth, and wants no help for which he will have to pay. The result is that his clients suffer to the aggregate tune of many million dollars per year. On the other hand, the ordinary consumer of light is satisfied if the effect is brilliant, irrespective of whether he can see properly. If he finds seeing difficult he damns the electric light as unhygienic or unsteady, or unreliable, or as anything in fact excepting an illuminant foolishly used. In fact the general public is pardonably but sadly ignorant of the principles of illumination. It still believes that the greater the number of brilliant lights visible in a building the better the illumination as a matter of course, whereas all things considered the best illumination is that which gives the required facility of seeing with the fewest visible lights.

Before the illuminating engineer can hope to have his profession taken into full and regular standing there must be a long campaign of education which has now only begun. The man who pays the lighting bill must be brought to realize that a waste of light is a waste of money, and that skill in arranging artificial lighting will save money just as surely as skill in planning the heating system will save coal. Next he must be educated to the point of understanding that the old methods of lighting produce bills instead of good illumination. And this is true even when lighting is deliberately intended to play an important part in decorative effects. This lesson was taught wonderfully well by the work of the late Mr. Stieringer in exposition lighting. He will remain as the great pioneer in illuminating engineering—a man with an instinctive genius for producing beautiful effects with the minimum effort and material, and with a marvelous intuition for putting just the right amount of light in exactly the right place. And there is acute need for men like him not only to deal with great problems, but to reform the lighting practice now in vogue and to teach the everyday economical use of illuminants. The trouble with the situation is that every architect and every wiring contractor is familiar with the average bad methods and generally unfamiliar with good ones, while their clients and customers know no difference. The illuminating engineer, therefore, must not only study but create his profession, and this is uphill work. The time will come when his work will be properly appreciated, but for the present we fear he will have rather

poor pickings, as does the electric heating engineer. The first step forward will come when some owner or architect is shrewd enough to put the lighting of a fine public building into the hands of a first-class man. One chance for a really brilliant success such as would thus be given will put the whole art on a new basis. Until then there is precious little to serve as a standard of merit, or to inspire progress, for ordinary illumination may be stigmatized as either wasteful or ineffective—and rather too often it is both.

Heterodoxy in Electric Power Transmission Doctrines.

Among the semi-popular lectures delivered in the meetings of the British Association at Johannesburg was one by Prof. Ayrton on "The Distribution of Power," an abstract of which is published in a recent number of the London *Electrician*. Prof. Ayrton is always an entertaining lecturer. The printed abstract of his lecture well maintains his record, but the principal interest in the lecture is its rank heresy, as regards electrical transmission doctrine. It is a plea for the superiority of the direct current over alternating currents, for long-distance, high-tension power transmission. At the present time there are numerous alternating-current power transmission systems in successful operation at pressures up to 60 kilovolts and distances up to 200 miles. There are, on the other hand, very few direct-current power transmission systems. Two only are referred to in the abstract of the Ayrton lecture, namely: the Combe-Garot to Le Locle system in France, which was installed in 1895 at a pressure of 14 kilovolts over a distance of 30 miles, carrying about 2,000 kw; second, the St. Maurice-Lausanne system in Switzerland, which was installed in 1902, at a pressure of 23 kilovolts, over a distance of 35 miles, carrying 3,400 kw. Both of these are Thury systems employing a constant direct current with generators in series at the transmitting station and motors in series along the circuit. The voltage at the generating station is increased as the load increases. It is stated that both of these systems have given satisfactory service, and as noted in our Digest columns for February 13, 1904, the company operating the Lausanne system, which receives the power on direct-current motors and distributes locally by three-phase currents, declared that they had never had an interruption of the direct-current service; although they had experienced stoppages owing to troubles in the alternating-current distribution. It is stated in the abstracted lecture that another Thury direct-current transmission system is in course of construction in France from Moutiers to Lyons, a distance of 114 miles, to carry 4,500 kw at a pressure of 60 kilovolts.

Upon these particular systems in France and Switzerland rests the entire direct-current case from the standpoint of practical experience. They show that the constant-current system can certainly be carried at least up to as far as 150 amp. and 23 kilovolts. It remains to be seen whether the pressure can be carried successfully by dynamos in series up to 60 kilovolts. Moreover, it is very doubtful whether such a system is capable of meeting the requirements of general power distribution, as distinguished from delivering power in bulk. That is to say, granting that power may be delivered to direct-current motors in series at a receiving station or stations, it is probable that as in the case of Lausanne it would be necessary to distribute the power through an alternating-current network of mains for city consumers. The comparison would, therefore, be narrowed to the use of motor-generators in the receiving stations as against transformers, with high-tension, alternating-current transmission lines. Meanwhile the pressures employed in alternating-current transmission lines have successfully reached 60 kilovolts; and 67.5 kilovolts is said to be in early contemplation. As for surges in transmission lines, they may occur in direct-current as well as in alternating-current lines. Resonance is a phenomenon peculiar to alternating-current lines, but it has ceased to have terrors for the electrical engineer. While, therefore, the experience with the coming 60-kilovolt Lyons system will be watched with great interest, we do not look for any revolutionary change in the industry of electric power transmission from alternating to direct current.

The Cascade Converter.

A description of a combination of an induction motor and a synchronous converter, which presents numerous points of theoretical interest, is to be found on page 698 of this issue. The form-wound secondary coils of an induction motor are connected directly to the alternating-current terminals of a synchronous converter, the armature of the converter being mounted directly on the shaft of the rotor of the induction motor. The equipment possesses simultaneously the characteristics of four machines, namely, a frequency converter, a synchronous motor, a synchronous converter and a direct-current generator. The advantageous features claimed for the machine reside in the fact that it may be fed with alternating current of any frequency and at any electromotive force, and that it will deliver direct current from a commutator operating at a frequency best adapted for satisfactory performance. To just what extent the machine will prove more economical in construction and desirable in operation than a motor-generator set, we are not directly concerned at the present moment. The chief interest centers in the inherent characteristics of the machine. As connected in the circuits, the input machine is a true induction frequency converter, the frequency of the current in the secondary depending directly upon the slip of the rotor from synchronism. A distinction between the performance of this machine and that of a simple induction motor is found in the fact that the slip is constant independent of the load, and that the power is transmitted from it partly electrically and not wholly mechanical. The slip assumes a value such that the secondary frequency is equal to the frequency of the e.m.f. generated in the armature of the synchronous converter. The load is determined by the demand for current from the brushes of the synchronous converter, and the torque required thereby is supplied simultaneously by the action of the secondary current on the field of the input machine and by the action of the armature current on the field of the output machine.

The e.m.f. in the secondary of an induction motor when the rotor is stationary bears to the e.m.f. of the primary the ratio of the respective turns of the secondary and the primary coils. This e.m.f. varies directly with the slip, and at each value of the slip it possesses a definite determinable value. If the input and output machines have an equal number of poles, then the normal operating value of the secondary e.m.f. of the input machine is just one-half of the value when the rotor is stationary. Since the operating e.m.f. of the output machine when the alternating-current leads are on open circuit, depends upon the strength of the stationary field, it would seem that there is a definite field strength to correspond to the normal operating conditions of the equipment. Since the output machine is similar in all respects to a synchronous motor, it is to be expected that an excess of excitation of its fields will cause the machine to draw from the source of supply a component of current, leading with respect to the e.m.f., and of a value such as to restore the magnetism threading the armature approximately to its normal value. Such leading current flowing in the secondary of the input machine should have the effect of assisting in supplying the exciting magnetomotive force of this machine, and thus of removing the lagging exciting current from the primary windings and thereby improving the power factor.

The Western Union Telegraph Annual Report.

The annual report of the Western Union Telegraph Company was presented to the stockholders last week. The discontinuance of race reports last year cut down the earnings of the Western Union Telegraph Company $215,755. The expenses increased $483,654, so that the decrease in net revenue for the year ended June 30, was $699,409. In regard to the loss caused by stopping the race news, President Clowry says:

"There was a large increase of revenue from message business, but the loss resulting from the discontinuance of race reports shortly before the beginning of the fiscal year made a decrease of $215,755 in the total earnings. Owing to the conditions under which the race service had been handled a proportionate decrease could not be made in the expenses, which show an increase of $483,654, of which amount $300,000 represents the cost of handling the increased message business."

During the year 67,477,320 messages were sent over the Western Union wires, against 5,879,282 sent thirty-eight years ago. The average cost per message to the company was 27.3 cents and the average toll was 31.6 cents.

In poles and cable 874 miles and in wires 29,152 miles were added to the plant. There were 356 new offices established. Of the total of 1,184,557 miles of wire on June 30, 306,736 were of copper.

In dividends $4,868,083 was paid out of the net revenue of $7,188,064. The cost of new construction was $1,288,279 less than in the previous year. This is the income account compared with 1903-4:

	1905.	1904.
Gross revenue	$29,033,635	$29,249,390
Operating expenses	21,845,570	21,361,915
Net revenue	$7,188,065	$7,887,475
Interest on bonds	1,227,200	1,157,700
Net profit	$5,960,865	$6,729,775
Dividends	4,868,084	4,868,071
Surplus	$1,092,781	$1,861,704
Previous surplus	14,881,429	13,019,725
Total surplus	$15,974,210	$14,881,429

The surplus, after the deduction of operating expenses and bond interest, amounted to $5,960,865 for the year, or 6.12 per cent on the $97,370,000 capital stock. Of the company's real estate in New York President Clowry says:

"Purchases have been completed of the properties 14, 16 and 18 Dey Street, west of and adjoining the company's main building at the corner of Broadway and Dey Street. These properties are available for extension westwardly on Dey Street of the present main building when the necessities of the business require it."

At the annual stockholders' meeting Harris C. Fahnestock and Thomas H. Hubbard were elected Directors to succeed Charles Lockhard and A. R. Brewer. James H. Hyde, Chauncey M. Depew, and J. Pierpont Morgan were re-elected.

The surplus available for dividends was $5,960,865, equivalent to 6.12 per cent on the outstanding stock. The company is paying 5 per cent on the stock; therefore, there was a margin over dividend requirements of 1.12 per cent against a margin of 1.91 per cent in 1904 and a margin of 2.32 per cent in 1903.

Gross earnings showed a decrease of $215,755, equal to ¾ of 1 per cent. Operating expenses increased $483,655 or 2.2 per cent while net profits decreased $699,410, equivalent to 8.8 per cent.

The important change in the balance sheet is the increase in funded debt of $3,000,000, issued according to the terms of the mortgage, making the entire $20,000,000 of the funding and real estate mortgage gold bonds authorized in 1900, now outstanding. The company now has a surplus of $16,603,969. In order to show how this surplus is invested the following statement of quick assets and quick liabilities is given:

Quick assets—	1905.	1904.	1903.	1902.
Securities (not leased cos.)	$13,750,749	$12,634,345	$11,459,416	$9,727,988
Real estate	4,957,432	4,682,606	4,765,130	4,765,130
Receivables	2,829,576	2,221,813	2,156,365	2,302,172
Cash	4,011,726	2,414,103	2,678,016	2,665,310
Total	$25,549,483	$21,952,867	$21,058,927	$19,460,600
Quick liabilities—				
Accounts payable	$4,213,832	$4,238,690	$3,696,244	$2,843,744
Excess quick assets	$21,335,651	$17,714,177	$17,362,683	$16,616,856

It is seen, therefore, that the company's net quick assets amount to $21,335,651, showing that all the large surplus and more, too, is invested in them. The increase of $3,621,474 in net quick assets is largely due to the proceeds of the $3,000,000 bonds disposed of during the year.

Do We Need Better Illuminating Engineering?

The Electrical Section of the Western Society of Engineers at Chicago opened its session with a meeting October 13, in which the above subject was taken up by J. R. Cravath, in a paper which was illustrated by about forty lantern slides.

In introducing the subject the author stated that he surmised that the subject of the paper would be received with widely different mental comments by those into whose hands it might fall. Those who made some study of illuminating engineering would answer the question emphatically in the affirmative. Those who had given no attention to the subject would ask first of all what was meant by engineering in connection with so simple a thing as illumination. The answer to the first question was simple. A full answer to the second would require a treatise. He believed, however, that enough of an answer could be presented within the limits of the evening's paper so that the average person would be convinced not only that the efficient use of artificial light requires considerable special engineering knowledge, but that there is a great need for the application of such engineering knowledge at the present time.

The author defined the term illuminating engineering as commonly used at present as applying to that special branch of engineering which has as its aim the efficient use of artificial light. It does not concern itself with production and distribution of light-producing energy, but with the utilization of light after it is produced in order to secure the best illuminating effects from an economical, artistic and hygienic standpoint. Its work consists mainly of the selection of the proper illuminant, the proper location of the lighting units, and their proper equipment as regards reflectors, shades and globes. As in most other branches of engineering, the fundamental principles of this branch are simple and easily mastered; but the knowledge of ways and means of accomplishing practical results and the technical data on these ways and means can only be obtained and kept in shape for ready use, as in other engineering branches, by long-continued work and study and by some concentration of effort along special lines.

The author then took up the discussion of some thirty concrete examples of lighting, showing that there is room for much more careful application of illuminating engineering than is now usual. The lantern slides with which this part of the paper was illustrated were taken from photographs of Chicago theatres, public buildings, residences, etc., many of which were of recent construction, and most of which, the author pointed out, could be materially improved as to the artificial illumination. In many cases the results were shown to be poor from an economical standpoint, as the useful illumination could be increased decidedly by small changes. In other cases both the economical and hygienic results were bad, as the arrangements were such as to be disastrous to the eyesight. Among the subjects taken for criticism were the Auditorium Theatre, the new La Salle Street Station, Orchestra Hall, lobbies of the Stratford and Majestic Hotels, Second Presbyterian Church, First Christian Science Church, two well-known lodge rooms, several hotel and residence bedrooms, dining-rooms and living rooms, completing the series with some examples of office desk lighting.

After having discussed these examples, the author called attention to the importance to the engineer of knowing just what results various types of reflectors, shades and globes will give, for on these he is largely dependent in his efforts to economically direct and diffuse the rays of light. To give this information, photometric curves are the most valuable and heretofore the most common source of information. In this connection the author brought before the society and made public for the first time a rough method of testing and recording performances of reflectors and globes, and of determining certain other matters that he had tried and found very useful for certain practical purposes.

Two model rooms were fitted up side by side exactly alike as to colors of walls, floors and ceilings. These rooms were designed to have dimensions approximately one-third the size of rooms 13 ft. square and 9 ft. high. By equipping these rooms with incandescent lamps of equal candle-power in different reflectors and mounted in the different positions found in practice, many valuable compari-

sons could be made and the results recorded by taking a photograph of the rooms as a pair, taking care to shield the source of light from the camera to avoid halation. This method of testing had obvious limitations and was not to be considered as a substitute for photometric tests. It also had some obvious advantages that photometric tests did not, in that the reflections from the walls and ceilings were given more value and the results were more easily understood and appreciated by non-technical persons. He selected for presentation as lantern slides the negatives from some of the most interesting and instructive tests in his collection. These tests illustrated in a very striking manner the distribution of light around an incandescent lamp with different reflectors and globes. Part of these tests were made to bring out the contrast between reflectors giving widely different distribution of light, while others were taken to compare reflectors intended for the same specific purposes.

The paper was discussed at length. Mr. Albert Scheible called attention to the fact that part of the present awakening as to scientific illuminating engineering was due to manufacturers who made globes and reflectors, the general use of which depended upon a technical knowledge of illuminating engineering. The Holophane Glass Company, which was the one he referred to, had found it necessary, in marketing its product, to educate electrical men and others in the science of illumination. He thought perhaps Mr. Cravath had taken into account too much the engineering and utilitarian side of the question without considering sufficiently the artistic. He thought both should be considered.

Mr. Cravath replied that he wished it distinctly understood that he did not advocate sacrificing the artistic for the sake of economy, but that usually the two could be combined, and this was one of the important points that he wished to bring out by his paper.

Mr. Harold Almert, speaking from the central station manager's standpoint, said that he wished something could be done to educate the artistically-minded woman who insists on putting colored paper shades several thicknesses deep over the lamps and then complains because she gets but little light and her electric light bills are so high. He also gave an experience of his several years ago with street lighting. He carefully planned the lighting of a Chicago boulevard so as to avoid as far as possible the great contrast between the light under the lamps and midway between. The matter of proper reflectors and enclosing globes was carefully gone into. When the job was finished he had the assurances of several authorities who saw it that it was the best lighted boulevard in the world. After an absence of several years he now noted that the present management had been studiously striving to make the mistakes he had tried to avoid; clear glass globes were being substituted for opal, so that now the boulevard presents a blinding glare from one end to the other.

Mr. W. Jac Marland described some of his experiences as contract agent for the Brooklyn Edison Company, and expressed the opinion that there is great opportunity for the work of the illuminating engineer, especially in large cities. It had been his policy when connected with the Brooklyn Edison Company to investigate consumer's complaints from an illuminating engineering standpoint, and in very many cases found complaints by customers were due to poor arrangement of lighting. He mentioned one case specifically where a very costly portrait had the appearance of having a cast in one eye, due to the streaked light thrown from the reflector placed over it. The owner of the painting was about to return it to the artist to have the defect corrected.

Some little discussion took place as to how far the artistic as against the economical and utilitarian should be considered in illuminating engineering. President S. G. McMeen summed up the situation very aptly by saying that it was the part of the engineer to lay clearly before his client various plans combining in different degrees economy and artistic effect, leaving it to the client to say how much economy he was willing to sacrifice for the sake of the artistic.

French Cable Dispute.

The Venezuelan Government telegraph department has offered to pay the French Cable Company for the use of the French lines since they were seized several weeks ago, indicating a disposition on President Castro's part to give way to pressure by the French Government. The company's representative refused to accept the offer on the ground of having no instructions to do so.

Wireless Litigation Favoring Fessenden.

The Fessenden liquid barretter patent has been adjudicated and sustained. In the issue of the ELECTRICAL WORLD AND ENGINEER for September 19, 1903, the new Fessenden system was described and illustrated, including views of his liquid barretter. Many claimants for this invention have appeared from time to time. Their claims were briefly reviewed by Mr. Collins in an article that appeared in the ELECTRICAL WORLD AND ENGINEER March 11, 1905. This article refers to such men as Wilhelm Schloemilch, Frederick K. Vreeland, Dr. Lee De Forest and E. H. Smythe as rival claimants. To these names must be added that of Captain Ferrie. (See the ELECTRICAL WORLD AND ENGINEER for May 6, 1905.)

It will be remembered that the liquid barretter is an improvement over the solid wire barretter formerly used by Prof. Fessenden. The liquid barretter was developed as a result of experiments for the purpose of adapting the prior Fessenden wire barretter for use in connection with a liquid. It consists of a cell comprising a suitable liquid and suitable electrodes, one of them, usually the anode, having only a minute surface exposed to the liquid, the wireless signals being caused by increase of current in a battery circuit in response to the action of received oscillations which pass through the electrodes and cell in parallel with the battery circuit. The minute electric surface may conveniently be the wire of which the wire barretter was made.

We give below a review of the decision of the United States Circuit Court for the Southern District of New York in the suit of the National Electric Signal Company vs. De Forest Wireless Telegraph Company, et al. The patent in suit was the Fessenden patent reissue No. 12,115, of May 26, 1903. The receiver in dispute is the one stated to have bee.. used by the De Forest Wireless Telegraph Companies in the Russo-Japanese war. It is said that the London *Times* and Captain James, its war correspondent, employed this receiver so successfully in the Sea of Japan that the Russian and Japanese Governments insisted that its use be stopped.

Prof. Fessenden in his patent illustrated a number of forms of the invention. One of them showed the two fine terminals; another a single terminal; another a glass-covered terminal, in which all but the part covered by glass was immersed in the liquid.

His Honor, Judge Hoyt H. Wheeler, in rendering his decision, discussed the most pertinent defences raised in the case and drew a distinction between them and the patent in suit. The De Forest and Smythe detector patents, Nos. 716,000 and 716,203, were copiously quoted in the opinion. The court said as to these defenses:

"It [referring to the testimony] also seems to show that the De Forest and Smythe receivers operated by bridges formed by the local circuit between closely parallel electrodes broken by the aerial impulse to give the signal, while this [the device in suit] does not appear to operate by the making or breaking of any such bridges, but by a fluid path between the electrodes at variable distances."

The court also held that a so-called "thin" or V-shaped edge of one electrode "parallel to the plane surface of the other," referred to in De Forest patent No. 716,203, operated by means of the making and breaking of the metallic bridges instead of by means of a fluid path.

The court held claims eleven, twenty-three and twenty-five of the patent valid and infringed, not finding it necessary to pass upon any of the others. Claim eleven, which is as follows, will give an idea of the breadth of the opinion:

"An electrical receiver consisting of a liquid and an extremely fine terminal projecting into the liquid, substantially as set forth."

Numerous publications were cited by the defendants in the suit, including prior patents to Fessenden, to Pupin for his electrolytic rectifier, to John Stone Stone, British patents to Schaefer, German patents to Neugschwender, many foreign and domestic publications.

It was claimed also that the invention was made by a former employe of Prof. Fessenden, Mr. F. K. Vreeland. As to the Vreeland defense the court held that his work was an employe's step in Prof. Fessenden's continuous investigations. The files of the ELECTRICAL WORLD AND ENGINEER were freely drawn upon by both parties to the suit both for alleged anticipatory matter and for illustrations of complainant's and defendants' systems.

One of the contentions disposed of by the court was that of the theory of the operation of the device. The Fessenden patent describes both the thermal and the polarization effects. Many writers have claimed that the device operated solely on the polarization theory.

The court held that any question of theory of action was immaterial in a patent case, and that the device sued infringed the claims of the patent, no matter what its mode of operation might be.

The record in the case is voluminous. It contains nearly 4,000 pages of testimony and exhibits. In the conduct of the case a large corps of counsel participated on each side. For the complainant appeared Messrs. Kenyon & Kenyon, William H. Kenyon, William F. Bissing, Esq., and George C. Dean, Esq., all of this city, and for the defendants appeared Philip Farnsworth, Esq., and Richard N. Dyer, Esq., the latter representing the interests of Frederick K. Vreeland.

It may be of interest in this connection to note that after a long series of tests of the liquid barretter between Forts Wright and Schuyler, in Long Island Sound, the government purchased two sets of apparatus, including the receivers, for use with their work in Alaska. Some of the difficulties which had been encountered were set forth by Gen. Greeley in his address at the last annual dinner of the American Institute of Electrical Engineers. Gen. Greeley stated:

"I put in a cable which cost $60,000 across Norton Sound; three separate years the ice carried out the cable, and it was then my duty to do something with the wireless telegraph."

Speaking of the results obtained, after considering the Fort Wright to Fort Schuyler system, including the liquid barretter, General Greeley says:

"And there is to-day across Norton Sound a signal corps system of wireless telegraphy in its seventh working month, over the 107-mile route, without a moment of interruption. Over this system thousands of words are sent to and fro each day, and on one occasion no less than thirty-five successive messages passed across this intervening space of 100 miles, and without there being a call for a 'repeat.' You telegraph men know what kind of service that is. This work has excited a great deal of interest in Alaska on account of our continuing to work during the past winter over the 107 miles of ice."

We are informed that the Fessenden system has for two years been in constant working operation overland between Washington, Philadelphia and New York.

Indiana Telephone Men Meet,

The first meeting of the Seventh District of the Indiana Independent Telephone Association, comprising Boone, Hamilton, Hancock, Hendricks, Johnson, Morgan, Shelley and Marion counties was held at Indianapolis October 11. There are 62 independent telephone companies operating in this district, and about 50 were represented. W. W. Mendenhall, of Westfield, vice-president for the district, presided. H. B. Sale, secretary and general manager of the Indianapolis Telephone Company, welcomed the representatives to the city and said the meeting was called to complete the organization in the most important district and stronghold of the independents in the state. Mr. Sales said the greatest trouble which the independent companies have heretofore experienced, has been the lack of organization. The proper thing for the independents of Indiana to do, now is to strengthen the weak members in the organization by giving them, as well as the people, to understand that the independent movement is a permanent and substantial thing, and will be, as it has been in the past, the greatest commercial and financial institution in the state. "There is invested in independent telephone property in Indiana," he said, "over $15,000,000, this for legitimate installation of telephones and toll lines. For this expenditure the independent companies have 170,000 telephones in operation against less than 30,000 by our competitors." Mr. Sale referred to the magnitude of the United States Independent Telephone Company recently organized in the East, the character of the men behind it, and explained the direct and indirect results and moral support such a movement will give to the independent movement.

Charles S. Norton, secretary of the Indiana Independent Telephone Association, explained the purposes of the association and the plan of organizing the several districts as branches of the State Association. Following Mr. Norton's statement the organization was perfected with Mr. M. L. Hawkins, of Noblesville, chairman of the executive committee, and Mr. Will Hough, of Greenfield, chairman of the committee on by-laws and rules.

The principal topic for discussion at the meeting was the advisability of adopting a "uniform system of accounting." The plan was generally indorsed as not only a time and money saver but in order to secure accuracy and simplicity. The advisability of merging all the independent companies of the Seventh District and operating them from one head was suggested, but this was stoutly opposed by the smaller companies' representatives.

The New York Central—New Haven Electric Traction Situation.

Mr. Frank J. Sprague has contributed this week to the *Street Railway Journal* a discussion of the critical situation that exists between the New York Central and New York, New Haven & Hartford railroads as to the adoption of different electric traction systems. The communication is given in full below:

AN UNPRECEDENTED RAILWAY SITUATION.

"After a most thorough investigation on the part of the New York, New Haven & Hartford Railroad's Electrical Commission," certainly a most astonishing preamble in more ways than one, yet so reads the trade notice which announces the placing of an order for 25 alternating-current locomotives, under conditions not stated, for operating both the through and suburban and passenger service on the New York and Stamford division.

Speaking, in my individual capacity as an engineer, and also from a railroad equipment and operating standpoint, I venture to assert that under the existing circumstances, and in view of certain special limiting conditions, this decision is an error of more than ordinary magnitude—one which no engineer knowing the facts should have urged, and one which, instead of advancing the application of electricity to trunk line service may very easily seriously interfere with it.

A discordant note this, I know, in that chorus of praise with which the technical press is resounding because of the "brilliant and progressive action" of the New Haven road, and yet I am led to this conviction after full consideration of all the factors of the problem, and without, I trust, shutting my eyes to any advantages which may accrue from all-round successful alternating-current operation. Such as are my conclusions, however, it seems but proper to state them with the same candor which I have always observed in speaking of engineering problems, for unless the wisdom of this action by the New Haven Company is promptly challenged it is likely that erroneous conclusions affecting trunk line operation may become temporarily settled convictions.

In what I have to say I disclaim any intent to speak for the Electrical Commission of the New York Central & Hudson River Railroad, of which I have been and am an active member, for whatever their individual opinions, and whatever may be that body's present or future official action it will undoubtedly be confined to problems affecting joint operation of the roads, and embody only those ideas to which all of its members can subscribe. Even less do I assume to speak for the railroad company in matters affecting its relations with another company operating over its tracks, but the public announcements made from time to time concerning developments on both the Central and the New Haven roads afford ample basis for my comments.

Furthermore, my criticisms are not dictated by any spirit of antagonism, practical or theoretical, to alternating-current development, concerning the possibilities of which I have well-defined notions, and the bearing of which upon railroad equipment I can, I think, perhaps judge as clearly as most engineers. I regret, however, that so seemingly bold a step has been taken where alternating-current operation must necessarily be handicapped by various physical, engineering and operative conditions over which neither the New Haven road nor the contracting company can have any control, which the nature of things makes it impossible to change, and which will surely interfere with the full fruition of the hopes of those who have committed themselves to this proposition; and further that it should be supported by some assertions concerning direct-current operation which will not bear inspection.

Generally speaking, I assume a trunk line railroad's chief concern is as to the methods by which it can best meet conditions which are forced upon it, from both a financial and an operative standpoint,

how it can improve and lower the cost of its service, and benefit its stockholders; and that it is not directly concerned in experimental development for the benefit of other companies, whether railroad or manufacturing. In fact, because of the necessity of maintaining effective and safe operation, it should be slow to commit itself to any radical departures save for the gravest of reasons.

The first queries which naturally arise are: Why has the New York & New Haven Railroad decided to adopt electricity at all, and what has determined the limitation of the particular zone selected?

Is it because the company has suddenly become convinced that the economy of electric locomotive operation is such as to warrant it in embarking at great expense in a more or less experimental venture, or is it so certain of it that it intends ultimately to adopt electricity throughout its main line, and meanwhile is willing to try it on its own as well as some one else's dog first, even at some possible great inconvenience?

I venture to assert that neither assumption is tenable, for not only is the latter most improbable, but even the first is not a strong enough motive to lead to the present action by the New Haven Company. The simple truth is that the New York Central and Hudson River Railroad was, primarily, because of a grave disaster in the Harlem tunnel, quickened into a more serious consideration of plans already under advisement, and being compelled by legislative act to locally abandon steam, had for practical operative reasons to further consider whether an extension of its proposed operation by electricity was not only feasible but necessary. The electrical zone thus determined necessarily included not only the yards, tunnel and viaduct in New York City, but, so far as relates to the operation of the New Haven trains, of the section of the Harlem road to Woodlawn, at which point the trains of that company deflect to its own tracks. Hence for that dozen miles it became necessary that provision should be made for the operation of all trains by electricity, no matter what the New Haven Company might otherwise have wished to do, and Woodlawn being impracticable as a point of change of motive power the operation had to be carried to some natural terminal division of suburban traffic, either New Rochelle, Portchester, or Stamford, where change could be conveniently made on trains intended for more remote destinations, just as the Central had decided for North White Plains and Croton.

The limited zone of present operation having been evident for more than two years, what would have been the ordinary procedure? Naturally, one would say, through executive and technical representatives to promptly enter fully into the investigation, and, if possible determination of plans which would affect joint operation, and which might further be acceptable for individual operation.

The New York Central Railroad took up this problem in a manner which I think has commended itself to the commonsense of the community, and ought to the engineering and railroad world, by bringing together in a commission outside independent technical advice and its own constructive and operative officers, and reinforcing them with all that was necessary for effective work. In spite of the criticism which those who have not this responsibility upon their shoulders are lightly given to express, I, for one, save in one particular, where the better decision had to be subordinated to external conditions, am satisfied with the results, whether measured by first costs of installation, determination of engineering facts and possibilities, or practical railroad operation. And, if I mistake not, the example thus made by the Central will not only help raise the standard of electrical engineering, but establish a precedent for the safe and economical determination of problems of vital concern reaching every operative department of a railroad.

No sooner had this commission undertaken its responsibilities than it generalized a harmonious plan, making use of every advance which had been made or seemed reasonably sure of fruition in electrical equipment and operation, and planned for a reliable and economical service to satisfy alike the public and the railroad company. The broad question of whether alternating or direct-current should be used on motor equipments had at the time to be settled in favor of direct-current, not only because of the unpreparedness of the manufacturing companies to reliably undertake the solution of problems of paramount importance by alternating-current methods, but also because of special engineering and other limitations. In my own mind there has not been a shadow of doubt of the wisdom of this decision, and that the results will be fully equal to those anticipated, in spite of any claims based upon what is hoped to be accomplished by other means now some three years later. And now what of this problem of the New Haven road, and how is it going to affect plans already formulated and being actively carried out?

Let us briefly consider the character of its service, and to what extent it meets with that favored condition advanced quite forcibly, although sometimes on mistaken premises, as specially adapted for demonstrating the advantages of alternating-current operation, namely, a long line with relatively infrequent units.

Operating in one direction there are in the twenty-four hours of a week day a total of sixty-seven trains run on passenger schedule, of which the runs of five end at New Rochelle, eight at Portchester and nine at Stamford, leaving forty-five for points beyond this division. Thirteen of the latter are scheduled not to stop at Stamford, and thirty-two of the sixty-seven are essentially local trains making frequent stops.

On the Mt. Vernon-Stamford section the schedule of these locals varies from twenty-three to twenty-seven miles an hour, and the station distances average 1.65 miles apart, while intervals between train stops vary from four to six minutes, quite comparable to the conditions on the express service of the Interborough system.

Woodlawn, the point of departure of the New Haven from the Harlem tracks, is a flag stop for four trains only, and Mt. Vernon, 1.6 miles farther on—or 13.63 miles from the Grand Central Station—is practically the first suburban station on the New Haven road.

As further illustrating the character of this service, it may be noted that in addition to the starts at 42d Street Station, these sixty-seven trains make only twenty-three starts below Mt. Vernon, but two hundred and eighty-nine in the 19.85 miles beyond, excluding, on the one hand, possible stops at the draw bridge over the Harlem, and on the other movement of trains in the yards at New Rochelle and Portchester.

The train movement is variable, intervals at stations in one direction varying from seven minutes to nearly three hours. But considering traffic in both directions, while at times there are no trains in motion on the Mt. Vernon-Stamford division, and for a period of about three and one-half hours when there is but one train at any moment, for the remaining time there is an average of a train every ten minutes, and sometimes as many as eight trains in the section. Any freight movement is, of course, an addition. The road, therefore, can hardly be classed as a long rural road with infrequent service.

About four months ago the New Haven road's expressed determination was to limit its electrical movement of trains over the equipped tracks of the Central; three weeks ago, after a period of three years of vacillation, during which time there was but a single attendance of any representative of the road at the meetings of the Central's Electrical Commission, a second attendance is accompanied by the announcement of the adoption of alternating-current locomotives, the intention to extend operation from Woodlawn to Stamford, the abandonment of multiple-unit suburban train operation, the handling of all trains by electric locomotives, and a possible call for electric power not alone on the direct-current third-rail section, but for a single-phase alternating-current supply to an overhead trolley on the balance of the division.

In eleven months the Central hopes to begin electric operation. It has taken that company two years to have developed by two great manufacturing companies an electric locomotive which can perform such part of its service as must be so operated, and months must elapse before any number are ready for use, despite the fact that they are built for a single purpose, and are to be operated on a single plan. The development of this locomotive has been accompanied by a running test of nearly 25,000 miles under every conceivable load and operative condition, on a track specially set apart day and night for this purpose.

Now by some wizard performance, the development of a new locomotive on other plans, designed to be operated both by alternating and direct currents, to have a double system of contacts, and control both for single and multiple unit locomotive operation, is promised in time to meet the already established conditions. Just here, and to have at first hand an authoritative expression as to proposed methods, I will quote from a paper presented at the recent meeting of the Philadelphia Convention of the American Street Railway Association by Mr. Charles F. Scott, as follows:

"While single-phase cars can be arranged to operate from a direct-current trolley wire, it handicaps in some measure the single-phase equipment. The addition of resistance to the car equipment

and the extra switches and the like for enabling the change to be made in the current supply are obviously objectionable. It is best, therefore, to keep single-phase equipments free from operation on direct-current if it be practicable to do so. When it is found necessary for them to operate from an existing direct-current trolley wire, the motors are connected two in series for 500 volts, and if there be four motors the two pairs may be connected first in series and then in parallel as in ordinary series parallel control. The transformer is cut out, and the control apparatus and motors operate substantially the same way as those on an ordinary car.

"Current may be taken from one phase of a two-phase or a three-phase generator. Current from the several phases of a polyphase generator may be used for operating different divisions of the railway.

"A polyphase motor taking power equally from each phase of the high-frequency circuit may drive an alternator, either single-phase or polyphase, for furnishing current to the single-phase railway.

"Trolley voltage [on direct-current operation], however, has been limited to approximately 500 volts on account of the limitation of the direct-current motor." The pertinence of these remarks will be apparent later.

Assuming, for the sake of argument, that an alternating-current locomotive of sufficient capacity to handle the New Haven trains can in the time required be developed, how will the introduction of alternating-current operation affect the elaborated plans of the Central?

That road is actively engaged in carrying out plans involving an expenditure of nearly sixty million dollars, much of it made possible by the advances in electrical development, and over ten millions is being invested in electrical equipment alone. Increase of capacity, however defined and elaborated, has been the keynote of its plans, and anything which threatens to impair, or in any way interfere with the full measure of its accomplishments must be subjected to rigid scrutiny, and if the threat becomes a fact, should meet with prompt and unceremonious rejection.

In what particular then does the proposed introduction of alternating-current locomotive operation into this territory promise to better or even equal that already provided?

The plans of the Grand Central Station show a terminal designed to obtain the maximum dispatch and economy in handling train service and passengers, and the minimum dead movement of all equipment. To accomplish this a double-track level is being provided, the upper for trains drawn by locomotives originating from points outside of the electric zone, and the lower to accommodate the movement and storage of suburban trains operated on the multiple-unit plan, this lower level being provided with a loop, storage tracks and the necessary cross-overs, and also for a possible, though improbable, connection with the Interborough system.

This loop is of 135 feet radius, less than that at the Brooklyn Bridge station of the Interborough, and on which it is manifestly impracticable to effectively operate any locomotive handling a ten or twelve-car train. This method of operation, designed for the New York Central trains, should without argument govern the operation of all trains which come into this terminal, and yet the proposal to use alternating-current locomotives means the abandonment of a multiple-unit train operation, at least on this section, by the New Haven road.

Assume that on second thought it recognizes the necessity of altering its conclusions so as to meet the imperative demands of terminal station movement and the traffic requirements of the public, what are the technical facts?

Simply that not only every locomotive, but every motor car—and in a suburban train of any length there must be several if not all motor cars where high schedule is attempted—must, according to present plans, be equipped with bow collectors for overhead trolley contact 22 feet above the traffic rails, and third-rail as well as overhead collectors for operation on the direct-current zone, must pass through a tunnel of only 15 feet in height and over special switch work in terminal yards, and must be provided with means for throwing one or other of these sets of collectors into operation and two distinctive systems of control, one for alternating-current and the other for direct-current operation.

When considering the difficulties which must be inevitably experienced in the change over from one system to another, and especially if the attempt is made to operate the suburban trains on the multiple-unit system, one wonders why, instead of adding to them by an overhead trolley from Woodlawn to Stamford, a properly constructed and protected third-rail operated at a moderate potential was at least not adopted for this experimental equipment.

To say nothing of the increased weights, and the liability of trouble and delay because of the extra apparatus and complications, and even assuming that these can, despite Mr. Scott's inference, be ignored, what will be the result in the matter of economy when operating in the direct-current zone, and what bearing will it have upon the capacity of conductors and supply at the Central's sub-station nearest 42d Street?

The alternating-current motors proposed are designed to work at a maximum of about 250 volts when at full speed, and when in the direct-current zone they must be coupled in series in pairs because of the higher potential. Locomotives, although equipped with four motors, can then be operated only with the two groups in series and parallel relation, and motor cars if equipped with only two machines must be operated with fixed relation of motors. The result will be that for locomotive operation there will not be the advantage of the direct-current four-motor series control provided on the Central's locomotives, and no corresponding two-series control for motor cars. Locomotives will, therefore, require an increase of over 100 per cent in current up to about twelve miles an hour, which constitutes a considerable part of the yard movement, and there will be a similar increase of direct-current requirements for two-motor suburban motor cars up to speeds of twenty or twenty-five miles an hour. In fact, the conditions will be worse than indicated, because if the motors are designed for 250 volts individual operation two in series will not be sufficient for the direct-current zone, where the regular potential will range from 600 to 650 volts.

No wonder, then, that in spite of local requirements, and the fact that the multiple-unit has become an accepted tenet of such character as to preclude the possibility of successful criticism, the New Haven road commits itself to the abandonment of that method of train operation, one of the strongest reasons and most legitimate excuses for the use of electricity.

Even its locomotives, be they ever so successful, would introduce an additional cause for trouble and complaint on account of the extra number and yard space required and because of the inability to pool the equipment.

Furthermore, should there be delay in providing them, it will mean a like inevitable delay in commencing electrical operation by the Central, because of the inadvisability of joint electrical and steam operation in the tunnels, a condition to which a long-suffering public will register an emphatic and justifiable protest.

In the matter of current supply, what must it be, especially in view of the limited time remaining before electrical operation will begin at 42d Street? Either there must be a single supply from the power houses of the Central for both alternating-current and direct-current operation, or direct-current supply for 12.05 miles by the Central's power house, and single-phase alternating-current supply for 19.85 miles from an independent station. In the latter case it is manifestly impossible to get the highest economy because of the great variation of load, and because only one part of the work, and that the more severe, will be performed by the independent station. Joint supply of the direct-current division is simply out of the question, because in order to meet the necessary conditions it would have to be through independent sub-stations, practically similarly equipped, and supplied by independent high-tension lines from the New Haven plant, which duplication, because of physical conditions, is impracticable.

The proper determination of the relative amounts of energy used by the equipments of the two companies under the complicated conditions of train operation, with supply from three main power stations and the necessary duplicate sub-stations feeding a common working conductor, would be most difficult. Nor could there be under such conditions of supply from independent corporations that effective control of current supply vital in times of emergency.

It must be remembered that the New York Central, while providing space for future increases of equipment, has established two power houses considerably removed from each other, one at Port Morris, and the other at Glenwood, near Yonkers; that these two stations generate polyphase currents which are transmitted to eight sub-stations, where they are converted into continuous current at 650 volts pressure which is delivered to the working rail; that at these sub-stations storage batteries of great capacity are to be installed, and in order to insure reliable operation of the rotaries

under the extreme variations of load due to the heavy train demands, extraordinary care has been taken to maintain a practical minimum of voltage variation and freedom from sharply fluctuating loads at the main stations.

Furthermore, these two main stations are tied together, and the sub-stations are supplied by a system of high-tension conductors of minimum number, so that either joint or independent operation of stations can be effected with the least delay and the greatest freedom from confusion and trouble.

While normally, at least during times of heavier traffic, both stations will be maintained in operation, the reduction of fluctuations and the reserve capacity afforded by the batteries is such that in an emergency one station could just about take care of the Central's service, and in case of a total temporary breakdown of the high-tension lines the batteries will have reserve capacity enough to carry the entire load for a short period. It will be seen, therefore, that a fundamental idea of the Central's equipment is that of insurance because of the great volume of traffic and the vital necessity of maintaining continuity of operation. If called upon to supply three times as much power as originally contemplated outside of its own necessities, there would, unless the capacity of both stations is increased, and also the number or capacity of certain of the high-tension feeders, be imposed upon it a demand which it will not be prepared to meet. The fact that two-thirds of this special demand would be of a sharply varying character, without any relief whatever from storage battery equalization would certainly tend to interfere with the attainment of results which have been considered fundamental.

But assuming that alternating-current supply is made from the Central's main station, how can it be done?

There are several theoretical possibilities: Single-phase, all from one section of the machines to step down transformers which in turn supply the trolley wire, or single-phase from all windings to independent transformers, from each of which a section of the road will be supplied.

Neither of these plans is permissible, because in view of the size of the train units there would be serious unbalancing of the phases, with consequent irregularities and unreliability in operation of the rotaries, especially when accompanied with material drops of potential, to say nothing of the possible overloading and burning out of some part of the windings, or the necessity of operating an excess amount of machinery.

An alternate plan, supply by all phases to transformers connected upon the three-phase, two-phase plan, the two phases supplying different sections of the road, is likewise objectionable for the same reasons.

An independent supply from machines specifically set apart for the New Haven's service cannot without great cost be made effective because of the existing system of distribution and switchboard arrangements. Only a limited supply of this sort could in any case be possible from the equipments now being provided.

A remaining possibility resides in the use of polyphase motors, which in turn drive single-phase generators to supply the trolley wire, so as at all times to make equal use of all phases. This seems to be the only practical method when rotaries are also to be operated from the same source, and when train units of the size under consideration are to be operated. This, of course, means the introduction into the sub-stations of that moving machinery so much deprecated by critics of direct-current operation.

Every specific condition surrounding this proposed equipment seems, therefore, to militate against that directness and simplicity of equipment essential to the claim of alternating-current operation, and which under more favorable auspices would have a fair chance of being demonstrated.

What, then, is to be gained, and by whom? The New Haven Company must make a serious expenditure, lessened possibly by utilizing current from another company in the direct-current zone, but this necessarily rendering less efficient the supply from its own station, if it has one for the alternating-current division, and it turns over its tracks and equipment, as well as operation, to an experiment in the hope of demonstrating such economy in electric locomotive operation as will warrant the enormous expenditure necessary for any serious extension of electric service on its main line.

The passengers seem to have been lost sight of, for there is no promise of a single additional train or higher schedule, or any improvement in service, save abolition of smoke, which nuisance seems to have assumed gigantic proportions.

The Central, when it fully comprehends the meaning of the proposed equipment, may find sufficient warrant to view with equanimity the entire disarrangement of its plans and the prostitution of its service to what may be fairly termed a craze for experimental development applied without regard to consequences, but I doubt it.

On the general subject of alternating-current and direct-current operation, I beg to add a word affecting, as it vitally does, conductor capacity and sub-station distances, it is unfortunate that Mr. Scott should make a statement to the effect that 500 volts has become the standard, and by inference must necessarily be the limit for direct-current operation, for the Central's rail supply will be at 650 volts, its direct-current motors are guaranteed for 750, the Berlin Elevated and the Zweisimmen Montreux roads are built for 800 to 850, reliable companies in Europe are supplying direct-current motors wound for 1,000 volts, and it may be safely assumed that in spite of apparent difficulties turbine operation of comparatively high direct-current dynamos is not an impossibility.

By all means let us have the utmost which can be gotten by either system, let every improvement and advance possible be attained. Every engineer stands ready to welcome accomplished facts, and to help in the progress of the art, but for the best interest of that progress it is vital to avoid not only unwarranted claims, but adverse statements which will not bear critical analysis.

Cost of Coal Handling.

In a paper read by Mr. Charles H. Parker before the recent Lake Champlain meeting of the Association of Edison Illuminating Companies, some figures are given as to the cost of handling coal at the South Boston plant of the Edison Electric Illuminating Company, of Boston. This plant consists of a tide-water pier with two unloading towers, an open-air storage yard with a traveling barge for handling coal in the yard, bunkers of a limited capacity at the boilers, and a system of conveyors connecting all of the above. The coal conveying apparatus is operated throughout by electric motors, varying in size from 10 to 100 hp.

Among other interesting information given in the article is an estimate of the deterioration of coal in the open storage yard. This is estimated to be 6.5 per cent, or taking into consideration that the coal contains 2.2 more moisture in the winter months than in the summer months, due to the ice and snow brought into the station with the coal, the net loss by weathering is placed at 4.3 per cent. The load factor of the station for the winter months was .566 and for the summer months .553.

It was found that unloading from a barge having large and well-placed hatches, an average of 90.5 tons could be handled, but with small hatches the capacity fell to 39.4 tons per hour. The cost of handling coal per ton from various vessels was as follows: From lighters, 5.27 cents per ton; barges, 8.04 cents per ton; steamers, 9.36 cents per ton; schooners, 15.04 cents per ton.

Taking into consideration all factors of cost, including cost of unloading coal to bunkers, to storage yard, from yard to bunkers, handling coal in the yard and cost of repairs to all coal machinery, the average cost of handling per ton was 15.35 cents, and the average kw-hours per ton of coal unloaded was 3.71. The total kw-hours required to unload the coal was about ½ of 1 per cent of the station output, which value will be considerably reduced as the result of improvements now being made.

A Striking Picture.

Mr. O. P. Austin, in a communication to the *National Geographic Magazine,* says: "In 1805 the world had not a single steamer upon the ocean, a single mile of railway on land, a single span of telegraph upon the continents, or a foot of cable beneath the ocean. In 1905 it has over 18,000 steam vessels, 500,000 miles of railway and more than 1,000,000 miles of land telegraph, while the very continents are bound together and given instantaneous communication by more than 200,000 miles of ocean cables, and the number of telephone messages sent aggregate 6,000 millions annually, one-half of them being in the United States alone. The world's international commerce, which a single century ago was less than two billions of dollars, is now 22 billions, and the commerce of the Orient, which was less than 200 million dollars, is now nearly 3,000 millions."

CURRENT NEWS AND NOTES.

THE HARVARD-MASSACHUSETTS TECH. MERGER.—According to a Boston press dispatch the corporation of the Massachusetts Institute of Technology on October 11 voted to discharge the conference committee and withdraw from further consideration of the proposal to merge the Institute with Harvard University.

A. I. E. E. IN BOSTON.—The Boston branch of the American Institute of Electrical Engineers held its annual meeting recently in the Lowell Building, Institute of Technology, when the following-named officers were elected: Chairman, C. A. Adams; secretary, H. D. Jackson; executive committee, C. L. Edgar, James I. Ayer, C. B. Burleigh, Dr. Kennelly, R. Fleming.

ST. CLAIR TUNNEL.—It is said that the reason for the delay of the Grand Trunk Railway Company in equipping the St. Clair tunnel with electricity is because the company is anxious to investigate the feasibility of Niagara power. The Board of Railway Commissioners for Canada, nearly a year ago, recommended the electrification of the tunnel, but this work has not yet commenced.

A. I. E. E. MEETING.—The 200th meeting of the American Institute of Electrical Engineers will be held at No. 44 West Twenty-seventh Street, New York, at 8.15 p.m., Friday, October 27, 1905. The general subject to be discussed at this meeting is "Lightning and Lightning Protective Apparatus." The following papers will be presented: "Some Experiences with Lightning Protective Apparatus," by Julian C. Smith, of the Shawinigan Water & Power Company, Montreal. "Performance of Lightning Arresters on Transmission Lines," by A. J. Neall, electrical engineer with the Westinghouse Electric & Manufacturing Company, "Lightning Arresters on Italian High-Tension Transmission Lines," by Philip Torchio, chief electrical engineer of the New York Edison Company.

ELECTRIFYING SWISS RAILWAYS.—The Swiss Government is giving serious consideration to the electrification of its steam railroads, for which purpose it has splendid resources in its water powers, and in the ability of its electrical engineers and manufacturers. It has a special commission on the subject, the secretary of which, Dr. W. Wyssling, of Zurich, in company with Mr. Charles Wirth, engineer to the Swiss Railway Department, has been making a tour of inspection in this country. They visited Pittsburg and Schenectady, the single-phase roads out West, the third rail section of the Long Island Railroad and other places of pertinent interest. Their report will be confidential, but will have an encouraging and optimistic tone. The two gentlemen sailed for home, via Genoa, last week, well pleased with their trip.

IOWA TELEPHONE ASSOCIATION.—The Southeastern Iowa Independent Association had its convention on October 10. The meeting was well attended and enthusiastic. Another meeting will be called in about 60 days to hear the report of a committee appointed to revise the constitution and by-laws to conform with the State and National-Interstate Associations' constitutions. The programme was as follows: President's address, J. C. Thorpe, Fairfield, Iowa; "Reorganization," S. S. Lichty, Vinton, Iowa; "Clearing House Methods," Charles C. Deering, Boone, Iowa; "Party Lines," W. D. Dunsmore, Oskaloosa, Iowa; "Toll Lines and Service," Frank McNally, Washington, Iowa; "Are Our Rates in Harmony with Our Investment?" Howard Herr, Ottumwa, Iowa; "Our Association: What is the Ideal?" O. H. Seifert, Eddyville; "What of the Future?" J. S. Bellamy, Knoxville; "Round Table—for Everybody"; "Does the Bell Love the Farmer?"; "Respecting Each Other's Territory"; "Toll Lines," and "Exchange Accounting."

MUNICIPAL OWNERSHIP is all the cry in the New York mayoralty campaign. Mr. W. R. Hearst, of the New York *Journal*, has been nominated on an independent, straight-out municipal ownership "platform," and Mr. W. Ivins, the Republican candidate, is out flat-footed for municipal ownership in every aspect, shape and form, as follows: "In the matter of municipalization of our public franchises, except on the point of the compensation payable on the re-assumption by the public of such franchises, I will listen to no adverse party interest. The principle is no longer open to discussion. I will appeal to the Legislature for the passage of a law condemning all existing gas plants, under the right of eminent domain, with power on the part of the city to enter into immediate possession, leaving the question of value to subsequent determination by commission. In this way the people will have relief at once, whereas any other method means indefinite delay. I will push the construction of a municipal electric and power plant, and enforce the rights of the city in respect to the underground electric conduits." The Socialist party of New York has denounced the Hearst campaign as fraudulent, it being thus characterized: "Of all the issues of the campaign, the one humbug, the worst humbug, is municipal ownership under William R. Hearst." In his utterances, the Tammany or Democratic candidate, has said that he could not approve a "confiscatory policy" of municipalism.

VALUE OF TELEPHONE FRANCHISE.—In a special report to Controller Grout, presented to the Board of Estimate, Engineer Harry P. Nichols, of the finance department, estimates the value of a New York telephone franchise at $7,750,000 for twenty-five years of operation. As soon as the Legislature took from the Aldermen their powers in franchise granting matters the Atlantic Telephone Company applied for a franchise to operate an independent telephone system in the five boroughs, promising connection with the outside cities of the United States. When the application was made to the Board of Estimate it was referred to the controller, as the law directs, that a price might be fixed. Mr. Nichols is in charge of the franchise bureau of Mr. Grout's department, and the papers were sent to him. The company made this offer: The charges to be never in excess of 5 cents per call where there is no guarantee by the subscriber to pay a fixed sum per annum. A rate of $66 per annum for unlimited service where telephone is in private residences. A rate of $108 per annum for unlimited service where telephone is located in place of business. As a return to the city for the privilege of operating for twenty-five years: First, to pay to the City of New York for the first two years a sum equal to 1 per cent, for the next three years a sum equal to 2 per cent, and for the remaining twenty years a sum equal to 4 per cent of the gross receipts from service rendered in the city. Second, to furnish and install in various municipal offices telephones to a number not in excess of 500. In addition to payment for franchise, the company would have to pay duct rental in the conduits.

CARNEGIE SCHOOL OF TECHNOLOGY.—A special dispatch from Pittsburg of October 15 says: "When the Carnegie School of Technology opens for business to-morrow morning there will have been launched an educational enterprise which the founder purposes shall be ultimately the greatest of its kind in the world. More than 7,000 young men and women from every part of the globe have made application for admittance as students. The great majority of these are from the United States, but France and Germany are liberally represented. Great Britain, China, Japan, the Philippines and Greenland also are asking for admission. Only one of the great group of buildings planned has been completed, and the total expenditures to date aggregate $3,000,000. Mr. Carnegie has agreed to give ten millions for buildings alone and as much more as may be necessary. One-third of the seven thousand applicants were rejected outright because they could neither read nor write. Many of these expected Mr. Carnegie to pay their railroad fare and living expenses for the school year, and some even thought the philanthropist would provide for their families while they were procuring an education. After a sifting process there were left 1,723 eligibles, and because of the limited accommodations to start with only 120 have been accepted for the beginning of active work. At first there will be no women, because there is as yet no provision for them. The tuition will be $20, Mr. Carnegie insisting on this nominal sum because he does not wish the students to feel that they were attending a charity institution. All books, tools and material will be furnished free of charge, the only expense to the students besides tuition being their board and lodging. The school is primarily intended to fit students for the practical things of life. Among the branches to be taken up at the start are mathematics, elementary and applied electricity, mechanical engineering, chemistry, physics, architecture and foundry work."

TROLLEYS BOUGHT BY STEAM.—The Boston & Maine Railroad stockholders have voted to purchase the Danvers and the Newburyport Railroads. Bond issues of $10,458,000 for purchase and refunding purposes and 42,037 shares of new common stock were authorized.

WIRELESS BETTING.—The chief of police of Chicago fears a development of betting by wireless telegraphy and proposes to establish an interference station to prevent it by "jamming." This neat little plan would, however, interfere very decidedly with legitimate operations also.

FRANKLIN INSTITUTE PROGRAMME.—The Franklin Institute programme of lectures for the season of 1905-1906 includes Dr. F. A. C. Perrine, of New York, on "Power Transmission"; Charles E. Waddell, electrical engineer, Biltmore estate, Biltmore, N. C., on "Forest Denudation and Its Effects," and H. F. J. Porter, of New York, on a subject to be announced.

UNDERWRITERS' ASSOCIATION.—The annual meeting of the Electrical Committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York City, on Wednesday, December 6, 1905, at 10 a.m. As in the past, the meetings will be open to all interested in the matter of rules for the installation of electric wiring and apparatus, as contained in the National Electrical Code.

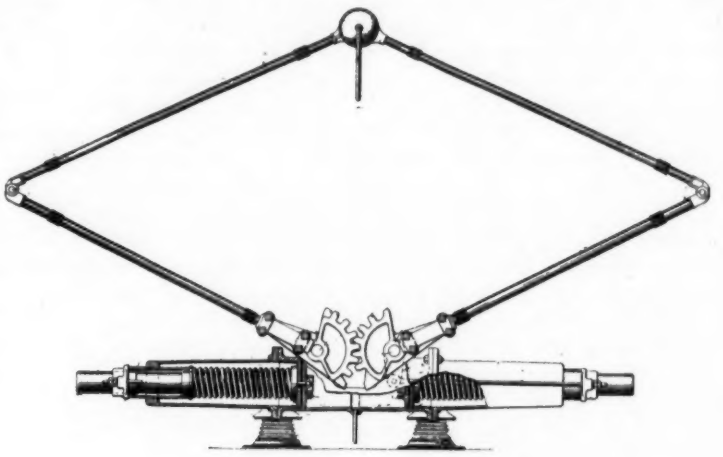
HYDRO-ELECTRICITY IN FRANCE.—Two new hydraulic electric stations are to be built in Lyons, France. In one a 200-ft. head in the Romanche River will afford 10,000 hp, which will be transmitted as three-phase current over a line 90 miles long. The other plant, at Moutiers, will supply 5,000 hp direct current at a potential of 57,000 volts, to be carried 110 miles on overhead bare copper wires. Where it enters the city the conductor will be placed underground in armored cables. The current will be transformed to a lower voltage by five motor-generators.

ALABAMA FREIGHT TROLLEY.—It is stated from Birmingham, Ala., that an important enterprise has been inaugurated by the granting of franchises to J. M. Dewberry and others, of Birmingham, for the building and operation of an electric freight and passenger line through the counties of Jefferson and Tuscaloosa to the Warrior River in the latter county. This road will carry Birmingham freight to the Warrior River, whence they can be floated to Mobile, giving the district its long-desired all-water route to the Gulf. The tonnage of the district is very heavy.

STEEL CARS.—The first all-steel car built in England was brought out early last month by the Brush Electrical Engineering Company, Limited, and its appearance is expected to answer fully some of the unfavorable advance comments in England on this type of car. It has been only a couple of years since the steel passenger car was introduced for roads operated by electricity. The American Car & Foundry Company built about 300 for the New York Subway and about 125 for the Long Island Railroad, 125 for the New York Central and 300 are in process of construction for the London underground road, and with a few less important orders a total of about 1,000 have been manufactured or have been contracted for. It is believed that this is only the beginning of a great change to take place during the next five years.

SIGNALING THROUGH CABLES.—A patent issued October 10 to Sir Oliver Lodge and Dr. Alexander Muirhead, of Birmingham, England, relates to the transmission of signals through submarine and similar cables. The object of the invention is to increase the rate of signaling. The inventors employ a condenser and inductance in series in a local circuit suitably proportioned in relation to each other as to give an oscillatory discharge. The current surges are conveyed to the cable either by reason of a part of the local oscillatory circuit being itself in series between the cable and the earth, or inducing an oscillation in a conductor which is in series. The surge used for signaling is sent on the depression of the key to discharge the condenser. The recoil surge in the opposite direction is depended upon to effect a suitable curbing of the signals so as to enable a high rate of working to be maintained.

BOW TROLLEY.—Two patents were issued on October 10 to H. P. Davis and C. Aalborg for trolleys for high-speed electric railways. According to one of these, the inventors propose to use a boom, which is moved up or down by means of compressed air. On the end of the boom is pivoted a bow, which is held against the trolley wire both by means of the compressed air and by means of springs, which allow the bow to assume an inclined position in one



or the other directions, depending upon the direction of motion of the car. The second patent relates also to a pneumatically-controlled bow collector. In this case, however, the bow is raised always in a vertical plane, the movement being restricted by means of a so-called "lazy-tongs" construction, as shown in the accompanying illustration. The central portion of the bow is cylindrical in form, and is so mounted as to rotate in service.

MUNICIPAL LIGHTING PLANTS.—With regard to the well-known book by Past President Francisco, of the National Electric Light Association, Secretary Eglin has issued a note to the members as follows: "The new book by Mr. M. J. Francisco, entitled 'The Business of Municipalities and Private Corporations Compared,' has been received at this office, and is a very convincing argument against municipal ownership of electric lighting plants. Mr. Francisco's former book, 'Municipalities vs. Private Corporations,' of which the new book is practically a revision and enlargement, was found by many of the members of the National Electric Light Association to be of very great benefit when combating the municipal ownership idea in their respective cities and towns. Mr. Francisco's statements are always carefully verified, and ought to carry the strongest conviction that up to the present time city ownership of lighting plants has proved in almost every instance a gigantic failure, and is likely to do so wherever undertaken."

MEETING GAS ARC COMPETITION.—In the discussion of illumination which took place at the meeting of the Electrical Section of the Western Society of Engineers in Chicago, October 13, Mr. Harold Almert, who has the supervision of a number of central station properties controlled by the L. E. Myers Company, of Chicago, told of a method he had found of meeting the strong competition for store lighting that is being put up in some places by gas companies offering gas arcs with cheap gas. This applied to places where stores had formerly a few electric arc lamps on a flat rate, burning a certain number of hours every evening. In such cases Mr. Almert suggested to customers who were dissatisfield and were considering going over to gas arcs that several more electric arc lamps be placed in the store and that all be placed on a meter basis instead of a flat rate. In this way the customer was able to frequently obtain a very much more brilliantly lighted store without much or any increase in lighting bills, and the threatened competition was kept out. The company's flat rates for arc lighting were of course based on burning a fixed number of hours each night, this number of hours answering the requirements of stores which close the latest. With the lamps on a meter basis, the customer could put them out as he pleased. Such a plan evidently increases the peak of the central station load without much corresponding increase in revenue, but under the circumstances it appears that some such concession is necessary to meet competition.

LIGHTING AT LOWELL, MASS.—Chief Hosmer, of Lowell, Mass., has taken a rather original position in his new specifications for street lighting. The bids will exclude electric lighting altogether. If this is carried out Lowell will occupy a unique position among American cities.

TOPEKA CITY PLANT.—It is proposed to sell the municipal electric lighting plant at Topeka, Kan. Mr. Frank B. Simms, of the city council, says: "It seems to me that this plant is a mighty big expense to the city considering the benefit we get out of it. We will have to enlarge the plant to give adequate service to the city and that will cost probably $15,000. Then we will have to pay about $5,000 more for new lamps. If we can dispose of this plant to some corporation that will do the city lighting at a reasonable figure it seems to me that it would be a good business proposition."

CLOCK OPERATION BY WIRELESS.—It is stated in German papers that Dr. Max Reithoffer, professor at the Vienna technical high school, has, jointly with the court watchmaker, Karl Morawetz, submitted to the common council of Vienna a plan for an electric system of clocks run by wireless electricity. They propose to furnish the chronometric and electric apparatuses, including clocks, to the city free of charge, and to make the trials. The city has only to furnish the current, the cable connections, etc., and give the use of suitable buildings. The common council has appropriated $600 for making experiments.

PROTECTING NIAGARA FALLS.—At Cleveland, Ohio, on October 6, the American Civic Association, at its session here, adopted resolutions calling upon the governing powers of the United States and Canada to do something to save Niagara Falls from what was termed "commercial vandalism." A committee was directed to send telegrams to President Roosevelt and Governor-General Earl Grey, requesting that they appoint a joint commission to suggest the best way of preserving the Falls for the benefit of future generations. A visitor to the Falls last week remarked that he had never seen them in fuller flood at this season of the year, all the enterprises together not having made apparently the slightest impression.

THE ENGINEERS' CLUB has just issued a handsome and interesting brochure giving an illustrated preliminary description of the new club house to be erected on East Fortieth Street, New York, flanking the new Public Library and looking out on Bryant Park. A simple, admirable account in some detail is given of the arrangements and there are plans of all the floors. The frontispiece is an elevation of the building in colored perspective. There will be 66 bedrooms, three electric elevators and an isolated lighting plant. The club is already the recipient of several generous gifts for the mechanical equipment. The new home will probably be ready next summer and will be occupied in the fall. The membership is about 1,250, and there is a long waiting list.

A ZOSSEN MODEL.—Mr. Edward D. Adams, the well-known financier of this city, and representative of the Deutsche Bank, has been presented by the Siemens & Halske Company, of Germany, with a superb model of its high-speed car with which such brilliant demonstrations were made on the Zossen military road sometime ago, using three-phase current. The model is exact in every detail of outward construction, and a great many of the working parts are also reproduced with closest exactitude. The scale is 1:20. The model was made by the apprentice force, which was sent into the field to make its measurements from the actual car itself as it stood on the track, without the working drawings. It is particularly interesting, in this model, to study the bow contacts for the three overhead wires, these having proved very successful in the final operative tests.

Electrical Engineers of the Times.—XXXII.

MR. H. W. FISHER.

Henry Wright Fisher was born at Youghal, Ireland, in 1861. His ancestors on his father's side were importers and millers of grain, and his grandfather was the first to introduce Indian corn into Ireland at the time of the Irish famine, thus preventing much suffering and starvation. In 1871 he was taken to the Argentine Republic, where his father had been entrusted with the management of a colonial enterprise financed by a London corporation. He was there about three years, receiving, during this period, instruction from an elder sister. On account of the poor educational advantages, his father, at the solicitation of American friends, brought his family to North Carolina where he purchased a plantation and became general manager of the Jamesville & Washington R. R. & Lumber Company, which some years previously had been organized by the late Richard S. Waring, of Pittsburgh, who also founded the Standard Underground Cable Company. In 1879 he attended the West-town Boarding School, near Philadelphia, staying there three years and receiving sufficient instruction to enter Cornell University in 1884. He was graduated in 1888, receiving recognition of work done in the University by election to membership in the Sigma Xi Society.

For a short time after graduation Mr. Fisher was connected with Bergmann & Company and the C. & C. Motor Company, both of New York City. In December, 1888, he entered the employ of the Standard Underground Cable Company in charge of its engineering work in New York City, and in October of the following year he became chief electrician of that company. Mr. Fisher at once commenced to increase the testing facilities of the laboratory and to conduct a great variety of experiments with a view to obtaining

HENRY W. FISHER.

needed data relating to electric wires and cables. This work has been continued ever since, and a large amount of useful information has been accumulated. For three years in the early part of the last decade Mr. Fisher was also connected with the Central District & Printing Telegraph Company, of Pittsburg, for which he designed a testing laboratory and located many defects in cables, etc. His present title is Chief Engineer of the Standard Underground Cable Company.

Mr. Fisher has visited most of the large cities and many smaller towns of the United States on engineering duty for his company. When its Oakland and Perth Amboy factories were under construction he undertook, in addition to his regular work, the duties of superintendent of the Pittsburgh factory, thus adding to his knowledge a thorough understanding of the practical manufacture of wires and cables. About 1900 he designed cable testing apparatus for the new factories and the construction department of his company, which proved of so much value that they are now regularly manufactured for the market by a firm of instrument makers.

Mr. Fisher has devised new methods of locating faults, several of which have been described in these columns, and has been granted several patents relating to cables and cable apparatus. He presented a paper on "Spark Distances Corresponding to Different Voltages" before the International Electrical Congress at St. Louis, and has contributed to the Transactions of the American Institute of Electrical Engineers, the Engineers' Society of Western Pennsylvania, and the Pittsburgh Academy of Science and Art—of which three societies he is a member—and to the technical periodical press. He is ex-president of the Engineers' Society of Western Pennsylvania and vice-president of the Pittsburgh Academy of Science and Art.

Electrical Supply in Hartford.

FARMINGTON RIVER, in falling 55 ft., develops the greater part of the electrical energy consumed in Hartford, Conn. Two widely different factors go far toward determining the percentage of the total demand for energy that can be drawn from the river, namely, the fluctuations in the rate of water discharge and the changes in the electric load. Between the different months of a year the electric load at Hartford, as in other cities, swings through a nearly regular cycle of changes with a minimum value about June and a maximum about December.

This series of changes in load demands is fortunately nearly in step with the varying rate of river discharge on the Farmington, as well as many other northern streams, so that with the certain rise of winter lighting loads there comes a nearly equal increase of the volume of water available for power. In addition to changes of load that come and go with the seasons, Hartford has presented for some years the problem of a rapidly increasing electrical output, for which no single generating plant can be expected to provide.

The ways in which the variations and increase in the demands of consumers has been met at Hartford are illustrated by the curves (Fig. 1). By these curves the energy output in kilowatt-hours per month of the Hartford Electric Light Company from January, 1898, to July, 1905, is represented. One curve represents the output generated by steam power, another the output generated by water power and the third and highest curve the total output.

For the curve of total output the most notable feature is its rise from about 200,000 kw-hours in January, 1898, to some 1,420,000 kw-hours in the corresponding month of 1905, representing an increase

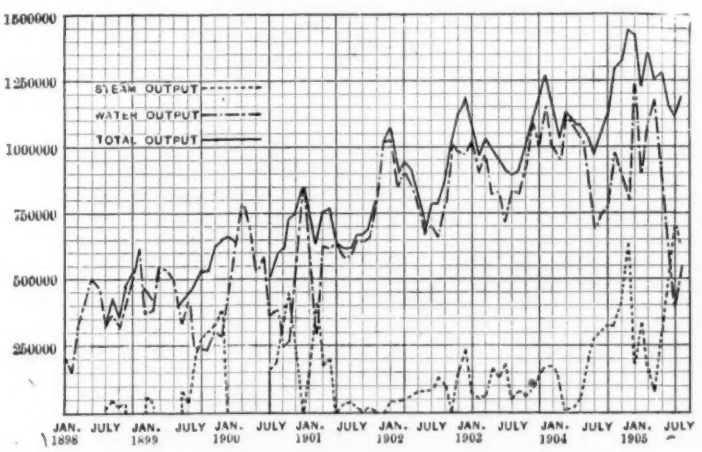


FIG. 1.—ENERGY OUTPUT PER MONTH IN KILOWATT HOURS.

of more than 600 per cent during seven years. It may be noted that this rise of output has gone on at a nearly uniform rate throughout the period named, as is shown by the fact that the December peaks of the curve lie in a nearly straight line. Another point worth noting is that the variation between summer and winter demands is coming to represent a smaller percentage of the total load. Thus for July, 1898, the output was some 330,000 kw-hours and for December of the same year the number was about 600,000 kw-hours, an increase of 81 per cent. In July, 1904, however, the output was fully 970,000 kw-hours, and in the following December some 1,440,000 kw-hours, an increase of only 48 per cent.

Comparing the water power curve with that of total output, it appears that the two coincided during the first six months of 1898, and in several shorter periods before the middle of 1900, as well as a few weeks in 1900. Perhaps the most interesting feature of the curve representing output from water power is its nearly parallel course with the curve of total output, showing that the rate of river discharge has varied approximately with the demand for electric energy during the months of each year. Since July, 1901, the similarity of the curves for water power and total output has been especially marked. In this same period, however, the curve of total output has been drawing away from that for water power, because of the increasing electric load. This movement has led to the erection of the new steam power station at Dutch Point.

Two electric water power plants on the Farmington River, each entitled to its entire discharge, supply energy for the system of the Hartford Electric Light Company. One of these plants, that at Windsor, began to operate in November, 1891, and the other, near Tariffville, was started during November, 1899. With these dates in mind the relations of the curves can be better understood. Though the first water power plant was able to carry the entire electric load during most of the time from January, 1898, to the middle of 1899, it fell rapidly behind in the second half of that year, so that the output from steam power was more than 360,000 kw-

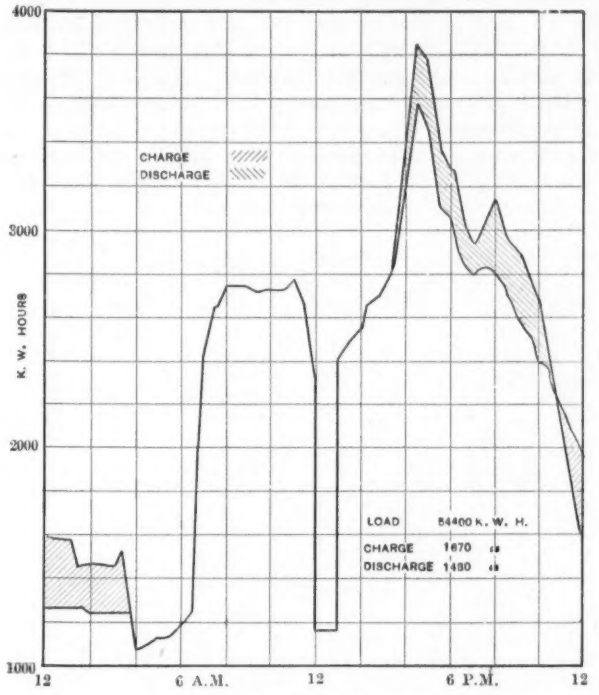


FIG. 2.—WEEK-DAY LOAD CURVE, DECEMBER, 1904.

hours during December. But the second water power plant that had been started in November of the last-named year, raised the capacity of water-driven generators to 2,700 kw, and these generators did all the work of the system from February to July, 1900. Owing probably to lack of water it was necessary to deliver some 450,000 kw-hours from steam power in November of this year, but the two water power plants carried almost the entire December load which called for 850,000 kw-hours in that year.

Since the last-named date the water power plants have generated

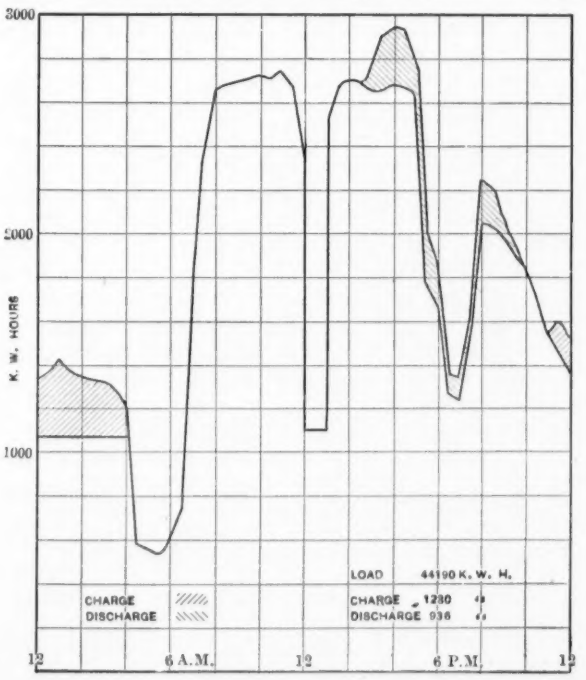


FIG. 3.—WEEK-DAY LOAD CURVE, JULY, 1905.

much the greater part of the energy output, but the energy drawn from steam power has necessarily increased in amount with the rising load, and was up to substantially 700,000 kw-hours in July, 1905, when the two water power plants sent out only 400,000 kw-hours. This is much the lowest output from water power in any month since February, 1901. To meet these conditions the Hartford

Electric Light Company decided on a large increase of its steam power capacity, and this has led to the construction of the new station on the bank of the Connecticut River at Dutch Point. With this new plant in operation the Pearl Street station, where the old steam plant was located, goes out of use for generating purposes, and its 1,500-kw steam turbine has been removed to Dutch Point.

Freed from the operation of a steam plant, the Pearl Street station retains its place as the chief center of distribution for the Hartford electric system, and receives energy from the two water powers and from the steam turbines in the new plant. At Pearl Street the regulation of the voltage for the distribution circuits is carried out.

Since the appearance of the general account of the Hartford electric system, published in the ELECTRICAL WORLD AND ENGINEER, March 8, 1902, the notable growth of supply from that system dating back to 1892, and there fully described, has gone on at an increasing rate. According to the figures presented in the above issue, the connected load of arc lamps was 1,824, in December, 1901, and now it is 1,984. In the year named the commercial incandescent lamps numbered 72,085, and now the corresponding number is 115,656, an increase of 60 per cent. To these figures must be added 3,848 meridian lamps and 3,804 Nernst lamps now in use. At the earlier writing the capacity of connected motors could not be stated, but it is now 5,474 hp.

Parts of these loads are operated with service transformers that number 365, and have a combined capacity of 5,740 kw, so that the average capacity is about 16 kw. Nearly all of the commercial output is sold on a meter rate and 3,479 meters are installed for the service.

The general scheme of feeders and distribution is shown in Fig. 4. All transmission and distribution lines at Hartford radiate from the general distributing station on Pearl Street, not far from the business center of the city. Energy comes to this sub-station over three underground cables, one of which connects with the new steam power plant at Dutch Point, and each of the other two joins one of the 10,000-volt, 60-cycle, three-phase transmission lines that run to the water powers on the Farmington River.

The junctions between the cables and the 10,000-volt lines are made in terminal houses where there are no transformers. Power at 2,400 volts is generated at Dutch Point and passes to the distributing station at this pressure. At this station the three-phase current from the two water powers is transformed to two-phase, and then mingles with the two-phase current from the steam power

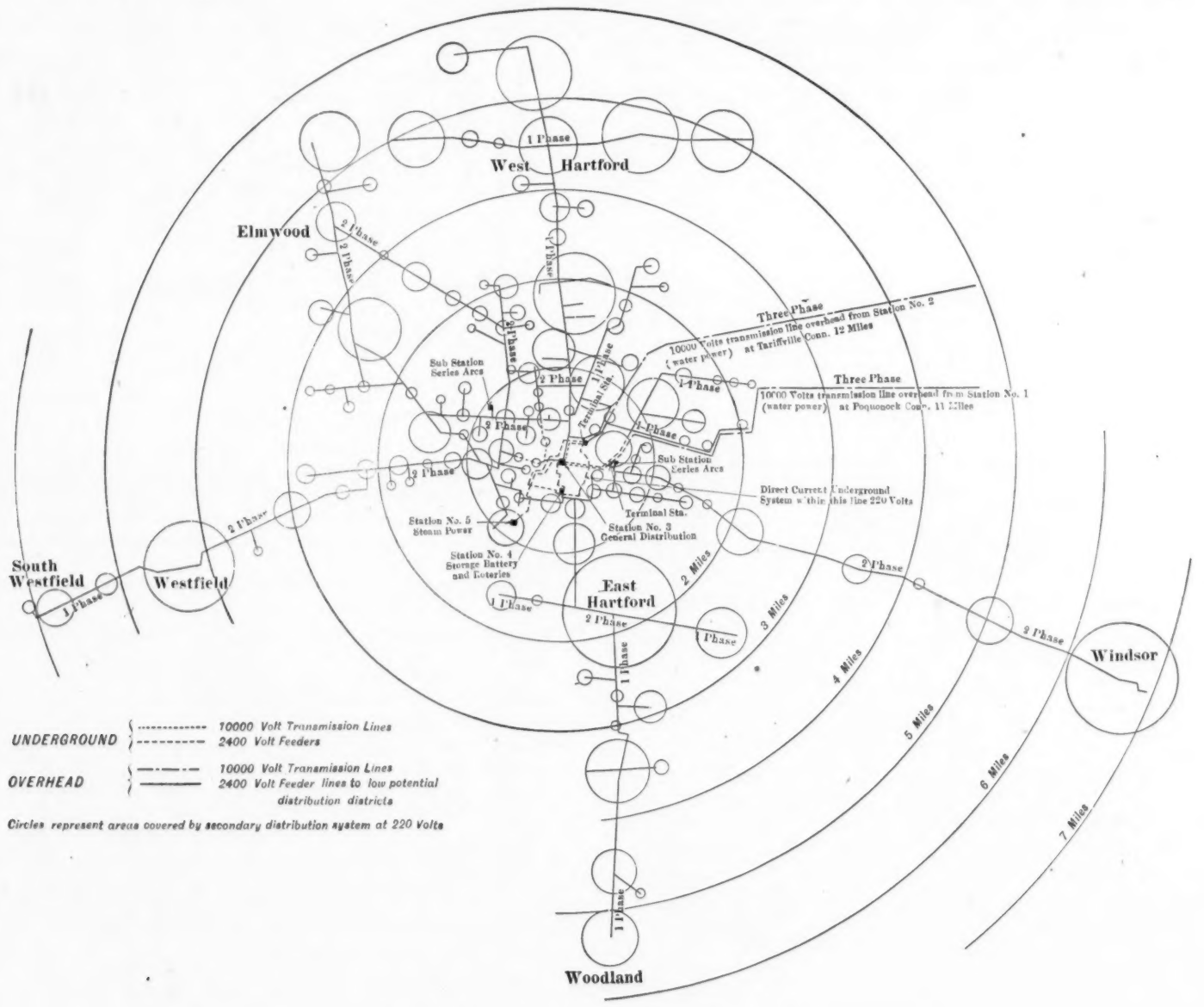

West Hartford
Elmwood
South Westfield
Westfield
East Hartford
Windsor
Woodland
Sub Station Series Arcs
Terminal Sta.
Station No. 5 Steam Power
Station No. 4 Storage Battery and Boteries
Station No. 3 General Distribution
Three Phase
10000 Volts transmission line overhead from Station No. 2 (water power) at Tariffville Conn. 12 Miles
Three Phase
10000 Volts transmission line overhead from Station No. 1 (water power) at Poquonock Conn. 11 Miles
Direct Current Underground System within this line 220 Volts
1 Phase
2 Phase
2 Miles
3 Miles
4 Miles
5 Miles
6 Miles
7 Miles
UNDERGROUND
10000 Volt Transmission Lines
2400 Volt Feeders
OVERHEAD
10000 Volt Transmission Lines
2400 Volt Feeder lines to low potential distribution districts
Circles represent areas covered by secondary distribution system at 220 Volts

FIG. 4.—SCHEME OF FEEDERS AND DISTRIBUTION.

plant, in the distribution system. Series circuits carry the arc street lamps and are operated by constant-current transformers. Commercial service to both lamps and motors is supplied by single-phase and two-phase current of 2,400 and 220 volts, and by direct current from a 220-volt, three-wire system. This three-wire system is underground and covers an area about 0.6 mile square, which includes the business center of the city. Beyond the limits of the three-wire system distribution is effected with 2,400-volt, single-phase and two-phase circuits which supply banks of transformers at intervals, and from these transformers 220-volt circuits radiate.

It is the practice of creating many minor distributing centers, instead of carrying the 2,400-volt lines to every building, that leads to the rather large average size of service transformers noted above. Some of the 220-volt secondary systems cover considerable areas. At East Hartford and also at Windsor the territory so covered is

in each case about 1.3 miles across. In Wethersfield the 220-volt system covers an area fully one mile wide.

The lengths of the 2,400-volt lines running to the outlying centers of distribution vary up to seven miles from the main distributing station in Hartford. Windsor, the most distant point supplied by the Hartford system, is seven miles from its center. South Wethersfield is six miles, Woodland is five miles and West Hartford is four miles away.

In total extent the 2,400-volt and 220-volt distributing circuits of the Hartford Electric Light Company now run up and down the Connecticut River a distance of fully 13 miles and east and west on both sides of that river a distance of ten miles. The expansion of the service area partially accounts for the rising curve of energy output.

On a weekday of December, 1904, the minimum load on the Hartford electric system was about 1,080 kw, and occurred at 4 a.m., while the maximum load was some 3,840 kw, at 4.30 p.m. (see Fig. 2). The storage battery carried about 240 kw of this maximum. For the 24 hours of the day in question the entire output of the electric system was 54,400 kw-hours, so that the average load was 2,266 kw, or 59 per cent of the maximum. In December, 1901, the maximum load of the Hartford system was about 2,840 kw, or 74 per cent of that in the corresponding month of 1904, and the average load for 24 hours was 1,341 kw, or only 59 per cent of the like average for the December day of 1904. It thus seems that the average day load increased almost 70 per cent in three years.

On a weekday of July, 1905, the minimum load of the Hartford electric system was 540 kw, at 5.30 a.m., and its maximum load was 2,960 kw at 4 p. m. (see Fig. 3). The total output for this day was 44,190 kw-hours, so that the average load during the 2.4 hours was 1,841 kw, or 62 per cent of the maximum load. At the time of maximum load on this day the battery output was about 270 kw. In July, 1901, the weekday load reached a maximum of 13.90 kw, or 47 per cent of the maximum on the corresponding day of 1905. For the July day of 1901 the average load during its 24 hours was 1,040 kw, or 75 per cent of the maximum, and this average load was 56 per cent of the like average on the July day of 1905.

These large percentages of average to maximum loads indicate the importance of the electric motor load on the Hartford system. As the average December load increased 70 per cent in three years, and the average July load 77 per cent in four years, it seems that the output of the Hartford system will double in five years from 1901.

Mr. Robert W. Rollins, general manager of the Hartford Electric Light Company, has made it possible to publish these interesting facts.

Electrical Hoisting Plant.

A recent issue of *Mines and Minerals* contains a brief description of an electrical motor-operated hoisting plant at Cobbinshaw. The plant has been designed for hoisting 80 tons per hour from a depth of 420 ft. The description is taken from a full report which has been prepared by Mr. Robert McClaren, H. M. I. M. The shaft is vertical and is three-quarters of a mile from the power house, where three-phase current is furnished at 440 volts and 50 cycles. The hoisting plant comprises two double drums with a direct-current motor, all on the same shaft; a motor-generator set with a fly-wheel between the motor and generator; an exciter set, an electrically-driven small air compressor with a receiver to furnish air for the brake. The motor of the generator set receives the current from the power house and drives the generator. The generator is a shunt-wound, direct-current machine designed for a speed of 750 revolutions a minute and furnishes current for the hoisting motor which is of the same type. The fly-wheel is 6½ ft. in diameter and weighs 13,000 pounds, and its function is to store energy so as to either aid or relieve the power line. The hoisting motor runs at a maximum speed of 57 revolutions a minute and is capable of furnishing 200 brake hp. The current for the field coils of the generator is separately supplied by a small 10-hp, three-phase motor driving a direct-current dynamo. The drums are 8 ft. in diameter each and 2 ft. wide. The brakes are of the post type, the uprights being of H section, 8 in. by 6 in. One brake is actuated by hand and the other by compressed air, the one with air being considered an emergency brake which comes into action automatically in case of an overwind. The load on each cage is 2,700 pounds net, and the hoisting speed about 23 ft. per second.

A Proposed Phase Regulator and its Applications.

BY P. G. WATMOUGH, JR.

ONLY the general principles and applications of this device are here presented, the actual constructional details being immaterial for the purposes of this article. Briefly speaking, the apparatus consists of a selective device, responsive only to phase displacement, in combination with, and actuating a relay mechanism, which controls or varies the field exciting current supplied to the generator or other alternating-current apparatus whose phase displacement it is desired to adjust through the medium of its field excitation.

Any form of selective device or phase indicator may, of course, be used, the one here proposed consisting of two magnetic field members placed concentric with each other; these are marked *G* and *H* in Fig. 1. The inner field or element is pivoted so that it can

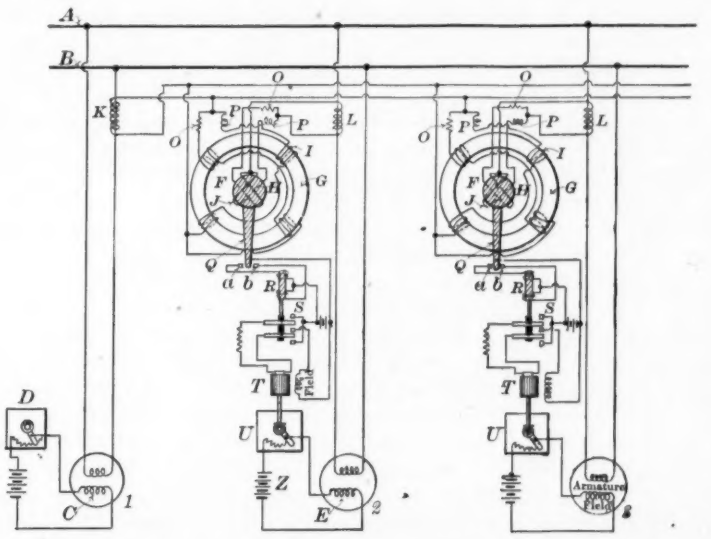


FIG. 1.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC EXCITATION.

rotate through a considerable angle; this mechanical detail is not shown in the drawing.

Polyphase field windings, preferably arranged for diphase currents, are placed on each member, so that a rotating field flux may be obtained in each structure when the windings are suitably energized. It is proposed to use a single-phase source of current to supply each polyphase circuit, the necessary two-phase effect being obtained by means of inductance and resistance suitably connected in series with the proper coils.

If connections are made so that both rotating field fluxes revolve in the same direction, the magnetic structures will tend to maintain a fixed and stationary relation with respect to each other, the exact points of opposition being determined by the interaction and relative phase displacement of the fluxes circulating in each member.

Any phase difference between the current in the windings on member *G* and the current supplying the coils on *H*, will produce a corresponding displacement between the interlocked rotating fluxes, resulting in a torque tending to cause member *H* to shift its position relative to *G*, by an angular amount dependent upon the aforesaid lag or lead between the currents. An index arm mounted on *H* and arranged so that it will swing over a graduated scale, will thus directly indicate the phase displacement existing between the currents energizing or exciting the two field structures. These currents may be derived from independent circuits or may be derived from the currents flowing in different branches of the same circuit.

If one field member is energized by a current due to the impressed e.m.f. of the circuit, and the other member is energized by the current flowing therein, then the instrument becomes a power-factor meter, for it measures the phase difference between the e.m.f. wave and the current wave.

In order that the instrument may be used as a phase regulator, the swinging index arm is equipped with a contact device arranged to close one or other of two relay circuits, the energizing of which sets in motion a motor that is suitably geared to the field rheostat of the machine whose field it is desired to control.

The arrangement and mode of operation of the apparatus are

more fully set forth in the description of the several applications to which the instrument may be put, which are herewith presented:

First, as a phase indicator or power-factor meter, the general mode of operation of which is outlined above.

Second, the automatic maintenance of zero phase displacement between generators or other alternating-current apparatus operating on the same circuit. The phase displacement here referred to is that caused by unequal excitation. The displacement due to the speed variation of the prime movers, being of an oscillating character, will exert no appreciable influence on the phase regulator if the latter has a greater period of oscillation than the former. This relation can readily be obtained. Phase control by speed variation is discussed later.

The most economical operating condition requires that the excitation current of each machine should be adjusted to that value which will produce equal terminal e.m.f's in the several machines on the circuit, under which condition the energy or load currents flowing in each machine will be of the same phase, and no wattless magnetizing or demagnetizing currents will circulate between the several machines.

In explanation of the general mode of operation of the apparatus, Fig. I may be referred to. *A, B* represent the bus-bars or line; *C, E,* separately excited fields; *D,* field rheostat, hand control; *F,* phase regulator; *G, H,* field members of regulator; *I, J,* polyphase windings; *K, L,* current transformers; *O,* resistance coil; *P,* inductance coil; *Q,* contact arm; *R,* relay, plunger and coils; *S,* reversing switch; *T,* motor armature; *U,* field rheostat; *Z,* any source of excitation. The encircled windings, 1, 2 and 3, represent single-phase, alternating-current generators, though the connections might also apply to synchronous motors, or any other synchronous alternating-current apparatus. It is also immaterial whether single-phase or polyphase machines are considered. Should any of the machines, say generator No. 2, have insufficient excitation, its current will be displaced in phase from the current flowing in generator No. 1, due to the lower terminal electro motive force; this phase difference will cause the moving element and contact arm of the phase regulator connected between generators 1 and 2 to assume a certain position dependent upon the amount of phase displacement existing.

If the contacts *a* and *b* are so adjusted that at zero phase displacement the contact arm just swings clear of both contacts, then the above phase displacement and resulting position of the arm, will close one or other of the contact points; one of the local relay circuits is thus energized, which through the medium of relay coil, plunger and reversing switch, starts into action the small motor operating the field rheostat, connections being such that the direction of rotation will cut out resistance, thus strengthening the field of generator No. 2. A corrective force is thus applied to the existing phase displacement, which will be gradually diminished by the increasing field strength, until zero phase difference exists between generators 1 and 2.

When this condition obtains, however, the regulator arm will assume its former position—wherein the contact arm swings clear of either contact—breaking the relay circuit, which thus allows the motor switch to fly open, and hence stops further movement of the rheostat motor.

The field of generator No. 2 is thus held at that value which tends to produce zero phase displacement with machine No. 1, for if the excitation of generator No. 2 had been unduly high, instead of low, as assumed above, a reverse series of operations would have been brought into play, resulting, however in the same final approach to phase unity.

In similar manner, any other machines connected to the same circuit, be they generators, motors or converters, may be held in proper phase relation with machine No. 1, which thus becomes the governing or "master machine" of the circuit; its field may be controlled by hand, or by any automatic means which will tend to hold the desired station voltage.

In stations where there are many units operating together, the above arrangement not only increases the efficiency of the plant—through the suppression of the wattless magnetizing or demagnetizing currents circulating between machines—which result is now approximately obtained by hand adjustment—but it also eliminates the time and attention now required of the switchboard operator in securing the above adjustment.

A third application is for the automatic maintenance of a predetermined power factor between any machine and the circuit to which it is connected. This is one of the most important uses for the instrument, and applies more particularly to the field adjustment of rotary converters, synchronous motors or rotary condensers, the specific object being to automatically adjust the field excitation of the one or several machines operating on the circuit, at such values as will maintain the power factor desired.

To obtain this result only a slight modification of the arrangement shown in Fig. 1 is required; the actual connections, however, are set forth in Fig. 2, where *A'* represents the armature and field circuits of the machine to be adjusted.

In this application the phase difference between the wave of impressed e.m.f. and the current wave in any particular machine, is the function to be controlled. Therefore, all the regulators on the circuit should have one of their magnetic elements, namely, the stationary element, as shown on the drawing, excited by a current de-

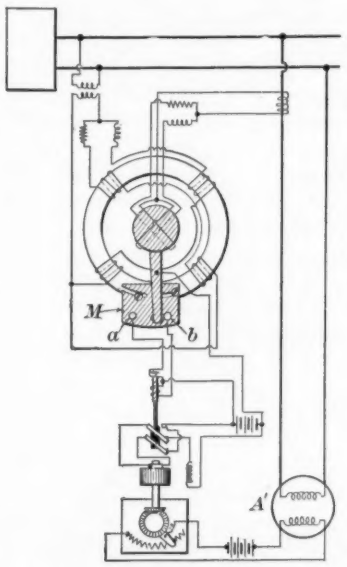


FIG. 2.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC MAINTENANCE OF PREDETERMINED POWER FACTOR.

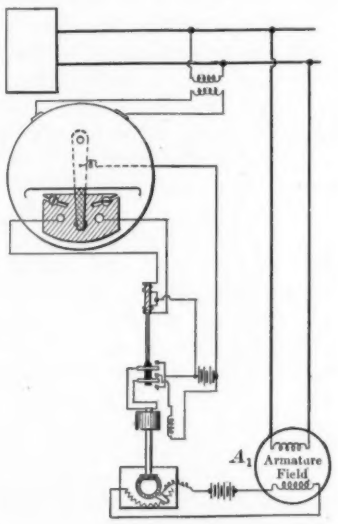


FIG. 3.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC MAINTENANCE OF CONSTANT VOLTAGE.

rived from the impressed electromotive force of the circuit, the windings on the other member of each regulator being energized by the particular machine to which the regulator is connected, and whose field strength it controls. With these conditions the relative position assumed by the contact arm in any regulator, is obviously due to the phase difference between the impressed electromotive force and the current supplied to that particular regulator; or in other words, is dependent upon the existing power-factor.

By referring to the second application it will be seen that the operating conditions are such that the field strength and resulting phase displacement of any machine are automatically held at that value which causes the regulator contact arm to swing clear of either contact. Therefore, by adjusting the contacts, viz., shifting them forward or back, various field strengths and corresponding phase displacements or power-factors may be maintained. The movable insulating plate *M* (Fig. 2) carrying contacts *a* and *b* indicate one arrangement by which the desired adjustment may be obtained.

A fourth application is for the automatic maintenance of constant voltage. Merely the relay and operating mechanism previously described are retained, the selective device or phase indicator being replaced by a voltmeter mechanism, the movable arm of which performs the same service as rendered by the contact arm in the phase regulator, closing one or other of the contact points *a* or *b*, depending upon whether the voltage rises or falls below a predetermined value.

Fig. 3 shows the general diagram of connections. The machine *A'*, whose field is controlled, may be either a generator, rotary condenser, or other synchronous apparatus. In the latter event the voltage regulation is obviously obtained through the action of leading and lagging currents produced by over or under excitation.

A fifth application is for the control of phase displacement due to speed variation. The general arrangement required is shown in Fig. 4; the essential difference from preceding figures, being in

to the valves controlling the speeds of the engines that drive the generators whose displacement is to be regulated. Obviously, the same end may be obtained by making suitable connection between the motor and the speed governors that control the engines or prime movers.

From the preceding discussion it is believed that the mode of operation will be apparent, and a brief explanatory statement will, therefore, suffice. Assuming correct excitation on the generator, the phase relation and distribution of the load currents flowing from

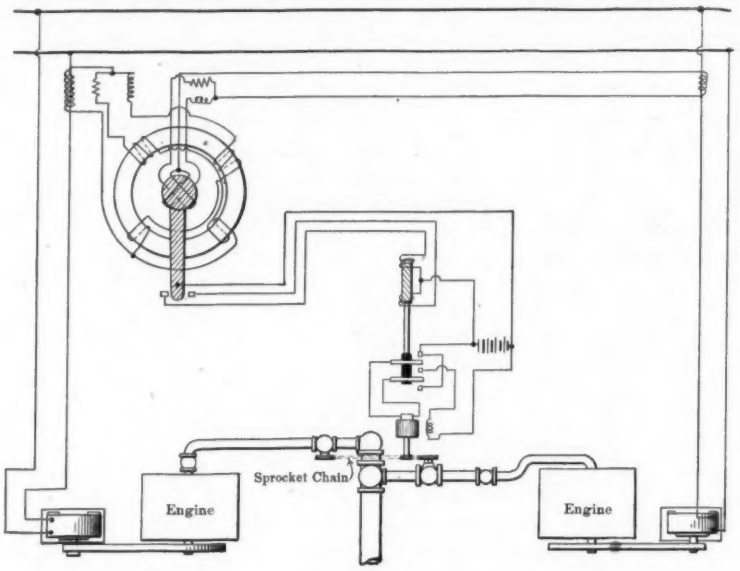


FIG. 4.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC CONTROL OF LOAD DISTRIBUTION.

either machine will be dependent upon the angular speed relations of the machines.

If the contacts are adjusted so as to clear the contact arm, when the current phases are in unison, then, if from any cause either engine should surge ahead or behind its companion, the resulting phase displacement of the generator currents and consequent movement of the contact arm will start in motion the small motor, its rotation being such as to close the valve of the leading engine and open the valve of the engine which is tending to fall behind. Thus a speed equalizing effect is introduced which tends to maintain the initial load conditions for which the regulator was adjusted.

It will be apparent that actual operating conditions may require combinations of the above applications, thus it might be desirable to maintain a group of several rotary converters in phase unison with each other, utilizing the connections illustrated in Fig. 1; the "master machine" of the group, however, if connected as in Fig. 2 would determine the power factor at which all the rotaries would tend to operate.

Different methods have heretofore been suggested for meeting one or more of the above applications. It is believed, however, that the particular mechanism proposed embraces several points of novelty, especially the idea of utilizing a "master machine" to which other machines on the circuit may be cophased.

Telephony on the Continent.

Mr. H. Laws Webb, the well-known English telephone engineer, recently returned from a month's trip on the Continent, devoted chiefly to looking into telephone progress. He visited Antwerp, Brussels, The Hague, Amsterdam, Rotterdam, Berlin, Munich, Berne and Paris, and inspected the telephone work and exchanged views with the telephone officials at those places. No very rapid development in the extension of telephony is, he states, occurring in any of the Continental countries, but the adoption of message rates in Germany has materially improved the rate of telephone development in that country, both in small places and in the large cities. The Berlin plant is being entirely reconstructed on the common battery system. In general, all new work on the Continent is being done on this system, and with but one exception all the large Continental telegraph administrations have adopted it, and are not extending or reconstructing exchanges with magneto plant.

Speed-Time Curves for Automobile Motors.

By FRANK B. RAE.

THERE are two defects that must be acknowledged in electrically-propelled vehicles: the distance they will travel is not great enough for many requirements, and the cost of maintaining the storage battery is very high for the mileage obtained.

The storage battery is a reasonably efficient converter of electrical energy, but it has a fixed rate at which it may be effectively worked. Current may be taken out of it at a certain maximum rate per square inch of plate, and this rate may not be greatly exceeded. When this rate is exceeded, disintegration of the active material results, the plates fail rapidly and the cost for renewal and repair becomes very high, and in some cases excessive. Makers of storage batteries are careful to state the maximum rate of discharge for the number of plates of a given size contained in the cell to be used; this discharge rate, however, is never maintained in vehicle work, and the makers very naturally decline to guarantee the life of the battery or give any assurance of a reasonable maintenance cost.

The proper discharge rate is constantly exceeded in the operation of the electric automobile to the extent of two to three times whenever the vehicle is started from rest and accelerated to full speed or accelerated from a slow to a faster speed, and as this is a constantly recurring condition of operation in city streets, it follows that the battery is as often subjected to a violent over-discharge rate with consequent damage.

The makers of electric vehicles, or perhaps more properly, the selling department of the manufacturing companies, also have ignored the limitations of the storage battery in rating the mileage of the vehicle. The radius of travel on one charge as stated by the selling agents is usually based upon the total watt-hour capacity of the battery as given by the battery makers; the operation of the vehicle is taken to be upon a level road without stops, and the general assumption is of an ideal condition of road and vehicle operation, which does not obtain in practice. Particularly do they fail to recognize the battery limitations due to a discharge rate above the normal, during the period required to accelerate the vehicle, which over-discharge very greatly decreases the mileage capacity of the battery.

The user of an electric vehicle is, therefore, confused as to what he may reasonably expect of the present design and equipment by the fact that the excess current consumption in starting and acceleration is generally ignored in rating the mileage of the vehicle, and that no approximate cost per year, or per 1,000 miles for battery maintenance can be properly predetermined.

The energy consumed in the operation of electric vehicles is usually stated in watt-hours per ton-mile or per 1,000 pounds-mile, but the number of stops per mile included in such rate or other conditions effecting this rate are not given. The watt-hours required to start and accelerate the total load to speed and the distance to do this, and the watt-hours required to operate the vehicle for the balance of a given distance should be ascertained separately, and the total watt-hours per ton-mile stated for one stop or twenty stops, or for whatever number it may be, within the mile or other distance taken. In other words, the distance which an electric vehicle will travel on one charge is not fairly determinable from a watt-hour per ton rate, unless such rate is stated in connection with the number of stops per mile, as the rate alters as the stops per mile vary.

The motors which are now very generally used by the builders of electric vehicles, and of which performance curves are made by the manufacturers, permit a predetermination of the current input required for a given weight and rate of acceleration and for running at speed; such determination is herein attempted, and is shown graphically in the curves of the accompanying illustration plotted from the calculations.

A controlling factor in predetermining the performance of a road vehicle is the resistance to traction, usually expressed in pounds per ton. This factor varies with the load, the character and condition of the roadway, the kind of tires used, the friction of the motors and gear and also with the speed. For twenty or thirty miles per hour, however, the resistance is practically constant for a given vehicle and load, and if it is assumed that good mechanical construction has reduced friction to a minimum, the variable conditions reduce to load, tires and roadway. One of the larger manufacturing companies gives the following figures as used by it in calculating the performance of vehicles equipped with motors of its make, and while

these figures are taken for the purposes of this article they are considered too low for average conditions by at least 15 per cent. They are used below, however, so that the determinations based on them may be entirely fair to the manufacturer:

For trucks and heavy vehicles.....	5 to 7 m.p.h.	30 lbs. per ton
For delivery wagons, hansoms, cabs, etc.....	12 to 15 m.p.h.	40 lbs. per ton
For runabouts and light vehicles.....	15 to 18 m.p.h.	40 lbs. per ton

This assumes a fair condition of road, asphalt, macadam or good block pavement, in about equal proportions, or the average roadway that the electric vehicle encounters in ordinary operation in city streets.

The curves showing the performance of an electrically-equipped vehicle have been obtained from the following data upon a truck of standard construction and equipment, and from reference to the performance curves of the motors as supplied by the manufacturer.

Total weight of truck, 9 tons (truck 4 tons, load 5 tons); maximum speed (as rated), 6 m.p.h.; gear reduction, 15 to 1; resistance to traction, 30 pounds per ton; rate of acceleration, 1 m.p.h. per second; motors used, two.

The capacity of the motors required for the above weight and speed of truck is $\frac{30 \times 9 \times 6}{375} = 4.3$ hp, and the two motors employed when operating at 800 r.p.m. and 90 volts are rated by the performance curve at 2.4 hp each, but are, of course, capable of a considerable overload for one hour or more, and of a large momentary overload.

For the acceleration taken (1 m.p.h. per second) the tractive effect is 91.23 + 30 = 121.23 pounds per ton, or 121.23 × 9 = 1,091 pounds for the total load. This is equal to $\frac{1,091}{2} = 545$ pounds per motor, exerted at the periphery of a 36-in. wheel. For the gear reduction as above, this tractive effect is equal to a torque on the armature shaft of 63.5 pounds at a radius of one foot.

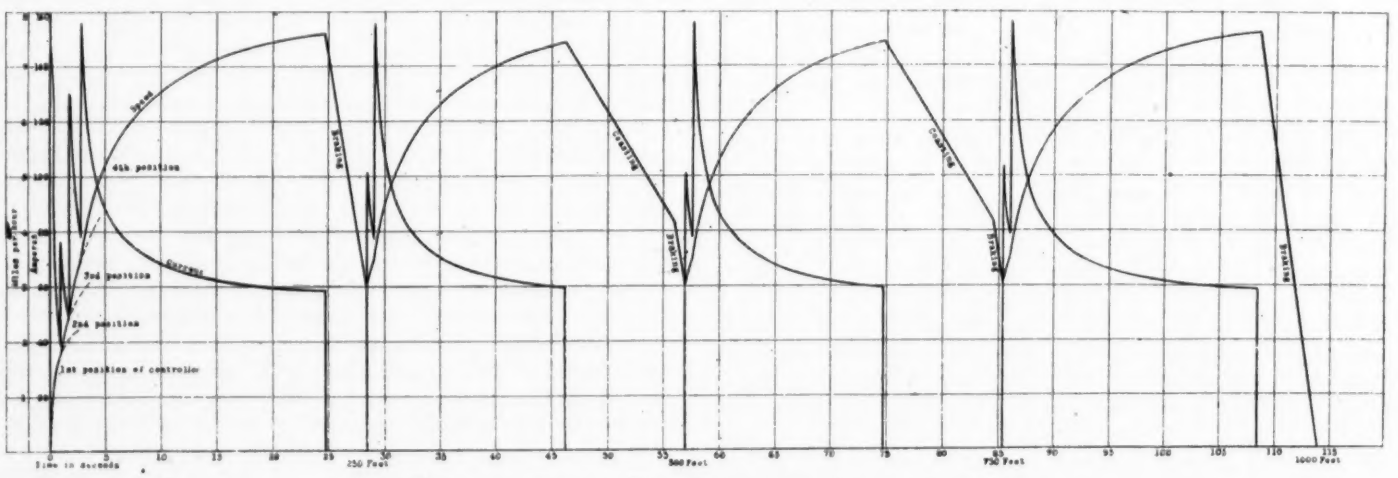
The controlling switch employed for this type of motor effects arate motors, and of both motors, in series and parallel across the battery. For the first position of the switch the full voltage is exerated across the two motors in series, and reference to the performance curve shows that the average tractive effort of 545 pounds corresponds to a current input of 48 amp. and a vehicle speed of 1.52 m.p.h. To reach this speed from rest takes .63 second.

For increasing the speed from 1.52 m.p.h. to 1.6 m.p.h. the average tractive effort operative during the time of increase is 520 pounds per motor less the friction, i. e., $520 - \frac{9 \times 30}{2} = 385$ pounds per motor. The rate at which the truck will accelerate is $\frac{385}{9/2 \times 91.23} =$ .94 m.p.h. per second, and the time to effect the increase in speed is $\frac{.08}{.94} = .085$ second.

A similar calculation for a speed of 1.77 m.p.h. shows that the limit in speed is reached for this point of the switch, and to maintain the average acceleration the second point must be taken, by which the initial acceleration is again made to reach 1.52 m.p.h. per second, with a corresponding increased torque and current input, which acceleration falls, however, to 1 m.p.h. per second and a final speed of 2.07 m.p.h. and a current of 61 amp. Further calculations for a speed increment of .4 m.p.h. or more results in the table from which the curve is plotted:

	Tractive effort per motor for 36-in. wheel.	Total mean current in amperes.	Rate of acceleration m.p.h. per second.	Time difference in seconds.	Total time in seconds.	Feet traveled.	Final speed m.p.h.
	1175	85.	2.55	...	.3	.26	1.
First position of controller.	860	67.5	1.77	.226	.526	.398	1.4
	590	51.	1.11	.108	.634	.232	1.52
	520	46.5	.94	.085	.719	.195	1.6
	435	41.	.73	.233	.952	.575	1.75
	760	76.5	1.52	...	.952	.575	1.75
Second position of controller.	730	74.	1.2	.108	1.06	.29	1.9
	590	64.5	1.11	.153	1.213	.445	2.07
	480	56.5	.84	.274	1.487	.880	2.03
	395	50.	.635	.220	1.707	.765	2.44
	820	130	1.67	...	1.707	.765	2.44
	725	118	1.44	.250	1.957	.960	2.80
Third position of controller.	580	101	1.085	.222	2.179	.95	3.04
	515	93	.93	.172	2.351	.787	3.20
	460	85	.79	.253	2.604	1.225	3.4
	420	80	.595	.144	2.748	.73	3.5
	780	156	1.99	...	...	.73	3.5
Fourth position of controller.	730	148	1.57	.207	2.955	1.108	3.8
	585	128	1.1	.31	3.256	1.804	4.14
	480	113	.84	.55	3.815	3.525	4.6
	395	100	.635	.63	3.445	4.44	5.
	325	89	.464	.863	5.308	6.58	5.4
	275	81	.317	1.262	6.57	10.36	5.8
	250	76.6	.280	.71	7.28	6.13	6.
	135	56	...	...	40.78	400.	7.8

For the traction resistance taken—30 pounds per ton—the final truck speed of which the motors are capable is 7.8 m.h.p. on a level. The schedule speed of the truck, however, is 6 m.p.h., the builders very properly leaving ample margin in the motors and controlling system to take care of an increase in the resistance to traction up to 50 pounds per ton or over, which may be the conditions encountered upon bad portions of the road, and which conditions are thus met without affecting the scheduled speed of 6 m.p.h.



SPEED-TIME AND CURRENT-TIME CURVES FOR AUTOMOBILE MOTORS.

Upon the basis of 30 pounds per ton, the time to reach a speed of 6 m.p.h. is 7.28 seconds. From the current-time diagram it is seen that the mean current input for the acceleration period is 88 amp., while the maximum current for acceleration to 6 m.p.h. is 156 amp.

It is to be noted here that the battery used by a vehicle of the type considered consists of 44 cells of 19 plates each, having a total potential of 90 volts and a catalogued discharge rate of 63 amp. for four hours, or a total capacity of 252 amp.-hours. The maximum current for acceleration shown by the curve is, therefore, 248 per cent of the the application of the small motor, which is here used to control the speed or driving force of the prime movers. The diagram represents the motor as being mechanically geared, by sprocket chain,

rated discharge rate and the mean current during the period of acceleration is 140 per cent of such discharge rate.

The distance traveled in attaining a speed of 6 m.p.h. is 43.6 ft., or .00825 mile, and, therefore, the watt-hours per ton-mile for the period of acceleration is $\frac{16}{.00825 \times 9} = 216.$

The maximum speed that must be attained by the truck in maintaining its schedule speed depends upon the number of stops made; if the stops are sufficiently frequent, the possible maximum speed of 7.8 m.p.h., which the motors will give the truck will not be enough to maintain the schedule speed of 6 m.p.h. The maximum distance that a loaded truck will travel without a stop in city streets may be conservatively taken to average 1,000 ft. The truck will slow up to half speed or less and accelerate to speed again, a probable average of three times within this 1,000 ft. This condition of operation is shown on the curve sheet and illustrates the attempt made to maintain the scheduled speed by running at the maximum speed attainable between points 250 ft. apart, at which several points the truck slows down to 3 m.p.h. and again accelerates to full speed.

The time required to run 250 ft. at the rate of 6 m.p.h. is 28.45 seconds. The rate at which the truck will brake to 3 m.p.h. will depend upon the urgency of the slow-down to that speed, and the retardation has probably a maximum at 1.25 m.p.h. per second. A braking curve is plotted to enclose the speed curve and 28.46 seconds to give the diagram the total area required to represent the proper average speed. It is shown by this diagram that the truck must accelerate to a maximum speed of 7.6 m.p.h. during 24.75 seconds, which is the time that current is maintained on the motors for the run of 250 ft.

From the area enclosed by the current time curve for the required 24.75 seconds it is ascertained that the mean current taken for this time is 69 amp., and the watt-hours are $\frac{69 \times 90 \times 24.75}{3{,}600} = 42.7.$

For the distance, 250 ft. ÷ 5,280 ft. = .473 mile, the watt-hours per ton-mile $= \frac{42.7}{.473 \times 9} = 100.$

For the next 250 ft. the acceleration is from a speed of 3 m.p.h., and to maintain the schedule of 6 m.p.h. the area enclosed by the mile-second curve must be the same as before. The time for acceleration from 3 m.p.h. is of course less than that from rest, and the speed of the truck may, therefore, decrease at the rate of 1.25 m.p.h. per second by cutting off the current earlier than for the first 250 ft. The area of the current-time diagram for this run is thus reduced to a value such as to require 71.6 amp. for 17.75 seconds, and the watt-hours are $\frac{71.6 \times 90 \times 17.75}{3{,}600} = 32$, and the average watt-hours per ton-mile $\frac{32}{.473 \times 9} = 75.3.$ This truck performance is duplicated for the succeeding 250 ft., the watt-hours consumed and the rate per ton-mile remaining the same.

At the end of the next 250 ft. completing the 1,000 ft. of distance, the truck comes to a complete stop. The area enclosed by the mile-second diagram must remain the same as before in order that the proper speed be maintained.

A braking rate from the maximum speed to a stop at a rate slightly higher than 1.25 m.p.h. per second is necessary, however, to maintain the required schedule, making the time that current is taken for this 250 ft. 23 seconds. The area embraced by the time-current diagram for this run and stop is such as to require a mean current of 68.5 amp. The watt-hours are $\frac{68.5 \times 90 \times 23}{3{,}600} = 39.4$ and the watt-house per ton-mile $\frac{39.4}{.473 \times 9} = 92.5.$

Should the truck be able to make the total distance of 1,000 ft. without slowing down and the schedule speed of 6 m.p.h. be maintained for that distance, then the total time required is 113.8 seconds. The maintained speed must average 6.25 m.p.h. and the current must be maintained on the motors for 104 seconds.

The average current for this total run for the time the truck is making its average speed is calculated from the performance curve of the motor to be 48.6 amp. There is required a mean current of 51 amp. The total watt-hours are $\frac{51 \times 90 \times 104}{3{,}600} = 164.$ For the distance 1,000 ÷ 5,280 = .19 mile, the watt-hours per ton-mile are $\frac{.19 \times 9}{164} = 96.$

The curve and foregoing calculations have shown that for a run of 1,000 ft., in which the truck slows down to half speed and again accelerates three times, and a speed of 6 m.p.h. is maintained, the total watt-hours expended will be 42.7 + 32 + 32 + 39.4 = 146.1 watt-hours.

To accelerate from rest and run the same distance, 1,000 ft. at 6 m.p.h. without slowing down, the energy exypended is 164 watt-hours.

The foregoing shows that an economy in the consumption of energy is effected by using high acceleration and taking advantage of the time the truck travels after the current is cut off to cover distance without power. This same economy has been pointed out in the discussion of electric railway traction problems. The other side of the question, however, as it relates to the electrically-propelled vehicle, concerns the greater loss in radius of action and the increased maintenance cost due to the high discharge rate during the repeated accelerations from a slow speed or a stop to full speed.

While the average current for the 1,000 ft. run with stops is only 71 amp., the battery has been called upon for a maximum discharge of 156 amp. three times in a period of 83 seconds.

The effect of stops and of the necessary acceleration to full speed upon the "watt-hour per ton" rate, and in which the best speed possible is attained, is shown in the following table, in which the total miles that the truck will travel on one charge is determined by dividing the watt-hours per truck-mile into the total watt-hour capacity of the battery (22,680 watt-hours) as stated by the makers:

Stops per 1000'.	Average speed in m.p.h.	Watt-hour per ton-mile.	Total miles on one charge.
0	7.8	71.8	35.
1	7.1	78.	32.2
2	6.5	85.	29.7
3	5.9	91.7	27.5
4	5.7	96.	26.4

The "watt-hour per ton" rate varies 34 per cent from no stop to 4 stops per 1,000 ft., and the decrease in the mileage of the truck is over 24 per cent. It is to be noted again that the watt-hours per ton-mile in the table and preceding calculations are based upon a resistance to traction of 30 pounds per ton. This is evidently too low for average conditions, and the vehicle mileage that is based upon this value will be too low. Both the rate and the mileage, however, will be found to vary for the stops made, in approximately the percentage given.

Power Station for the London Post Office.

From the London *Electrical Engineer* it is learned that the new Post Office power station which is being erected on the south side of the Thames, near Blackfriars Bridge, will contain machinery having an aggregate capacity of about 2,000 kw. Electric power will be provided for pneumatic tube work, lighting, elevators, fans for ventilation, for the operation of stamping and obliterating machines and for charging batteries for telegraph and telephone work. At present this power is obtained from the plant in use at St. Martin's-Le Grand, and from the power station at Mount Pleasant, but the Post Office authorities consider that the larger engines and boilers in the St. Martin's building are a source of considerable risk and inconvenience. In addition, the present position does not admit of the extension which the immense amount of work devolving on the Post Office machinery necessitates.

The European Single-Phase Railways.

ALTHOUGH the majority of the long distance electric railways in Europe are operated by either direct-current or polyphase motors, and while European engineers have for a great while advocated the adoption of polyphase motors for general traction purposes, it is worthy of note that numerous single-phase railways have been installed in that country since the announcement by American engineers, notably Mr. Lamme, in his now historical Institute paper, that a solution of the interurban traction problem was to be found in the use of a single-phase commutator motor. We give below an outline description of several of the single-phase roads which have been in successful operation, together with a brief notice of some roads which are now being equipped with single-phase motors. Our columns from time to time have contained matter descriptive of the various roads here dealt with. It is the intention of this article to bring the descriptions down to the present date, to record information which is not elsewhere available, and to discuss the results of experience with the different types of equipment.

SPINDLERSFELD.

This is an experimental line, installed by the Allgemeine Elektricitats Gesellschaft, near Berlin, Germany. It is 4.2 km. in length, the trolley e.m.f. being 6,600 volts, and the frequency 25 cycles. The road was placed in operation in June, 1903. There are two 52-ton motor cars in use. Each car is equipped with two 110-hp Winter-Eichberg motors. The motors are four-pole machines and weigh 2,300 kg. They are designed for an air-gap of 3 mm. A regular train consists of two motor cars and three trailers. The trolley wire is principally of the double-catenary construction. Two trolley poles are used. These are raised by means of air cyclinders. Each pole has a direct mechanical lever connection which locks the door of the high tension compartment when the pole is raised. When the pole is down and the door is open, a mechanical switch short circuits the high-tension line inside of the main fuses. The roof of the car is covered with a well-grounded netting and rail, the whistle cord and all piping being securely grounded. The height of the trolley conductor is 4.5 meters, and it is supported from the catenary at intervals of 3 meters.

MURNAU-OBERAMMERGAU.

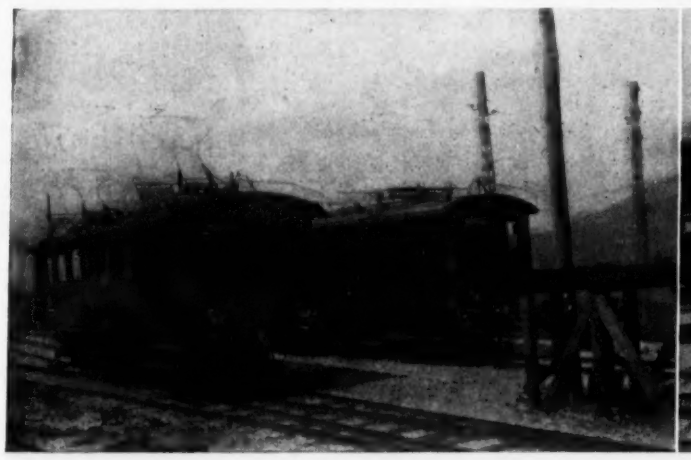
This railway is situated in the Bavarian highlands and serves to connect Murnau, a station on the Bavarian State Railway, with the village Oberammergau, noted for the passion play. The line is 23.6 km. in length and is fed with 17-cycle, single-phase current directly at 5,500 volts. It was placed in operation in January of the present year. The motors, which are of the conductively-compensated series type, were supplied by the Siemens-Schuckert Company. They are ten-pole machines, designed for 270 volts. The air-gap is 2 mm. on each side. The normal armature speed is 540 r.p.m.

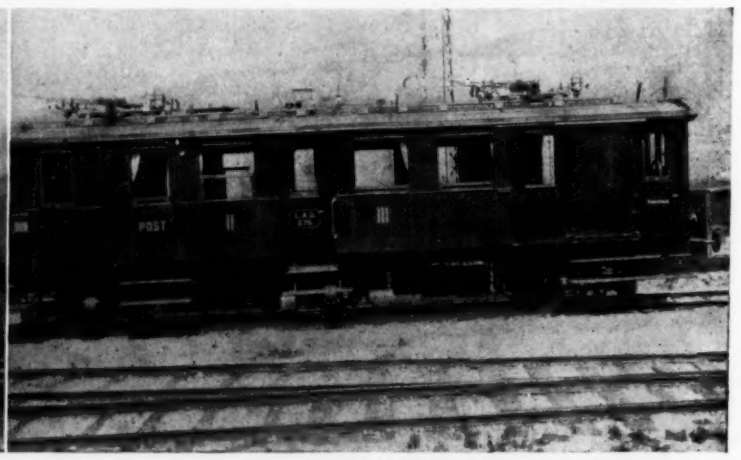
There are four cars, each equipped with two 80-hp motors. Each car weighs about 35 tons. The motors are subjected to voltage control, ten taps being provided for this purpose on the secondary of the main transformer. Both the controller and the transformer are mounted beneath the car, the controller being operated by means of a large wheel geared to a connecting shaft. A solenoid blow-out is used in the controller, and the current is always interrupted by the circuit breaker. A recent inspection showed that there had been very little burning in the controller after several months of service, and that the commutators operate with entire satisfaction.

The line construction is in general of a first-class interurban type. The poles are spaced 35 meters apart on straight track and 30 meters on curves. Span wires are mounted on porcelain insulators, held by wrought-iron side brackets attached to the poles. Porcelain strain insulators are inserted in the span wire, so that the trolley is doubly insulated. The insulation is subjected to a test of 32,000 volts under conditions equivalent to a rain storm. On 1.1 km. of straight track, a form of catenary line construction is used. A steel messenger wire is suspended above the middle of the track from porcelain insulators mounted on wrought-iron side brackets. The steel wire supports two trolley wires which are placed in a zig-zag course over the rails in the same horizontal plane. This construction is used in order that the rubbing contact on the bow collector may shift from side to center on each half and yet the resultant pressure will always be central. It is believed that this construction is especially advantageous for high-speed and high-power work. At the stations, road-crossings and yards, a loop connected to the trolley encircles a grounded conductor, so that in case the trolley wire becomes broken at these points, the line will be immediately grounded.

STUBAI VALLEY.

This road commenced operation in August, 1904. It is situated near Innsbruch in the Austrian Tyrol, the length being 18.2 km The trolley e.m.f. is 2,700 volts, and the frequency 42 cycles. The motors are of the Winter-Eichberg type and were supplied by the Allgemeine Elektricitats Gesellschaft. There are four motor cars, each of which is equipped with four 40-hp six-pole motors, and weighs 21 tons. There are six trailers for passengers and two open and two closed freight cars. A regular train consists of one motor car and two trailers, the rated speed being 24 km. per hour. The motors on each car are connected in two groups, the stators of each group being in parallel and the rotors in series. Each car is equipped with a main oil-cooled transformer weighing 1,100 kg., and two regulating transformers each of which weighs 150 kg. There are two taps on the main transformer, at 400 and 500 volts, respectively, and three taps on each regulating transformer. The taps on the regulating transformers are for supplying variable voltage to the rotors. The controllers are of the same size and external appearance as those used on street cars, and have six steps. On the first three steps a pressure of 400 volts is impressed upon the primary of the motors; on the following three steps the primary pressure is 525 volts. All of the different steps correspond to different taps of the regulating transformer. Any step can be used continuously. It was found that the original motors over-heated somewhat and they are being replaced with machines 30 per cent larger and having about 60 per cent more commutator segments. Each of the new motors weighs 1,200 kg. The rotor is about 18 inches in diameter, the commutator having a diameter of 17 inches. The wheels are 86 cm. (34 in.) in diameter. The gear ratio is 1 to 6. The commutators are sand papered once each





FIGS. 1 AND 2.—MURNAU-OBERAMMERGAU RAILWAY.

week, or after a run of from 1,000 to 1,200 km. A recent inspection showed the commutator which had been in service for 15,000 km. was yet in fair shape although slightly rough. The trolley wire which has a cross-sectional area of 53 sq. mm. is supported from a steel catenary wire having a diameter of 5 mm. at intervals of 4 meters. The poles are spaced not over 40 meters part. Section insulators are used in the trolley wire at intervals of 1 km. The normal height of the trolley wire is 5.5 meters above the rails, except in tunnels where the height is reduced to 3.9 meters. In tunnels the trolley wire is carried on rigid supports from insulated bars about five inches from the arch of the tunnel. Porcelain is used exclusively as an insulating material.

The trolley pole is of the single-bow type. The bows last for a travel of about 4,000 km. For the purpose of insuring safety to the employees and passengers, the roofs of the motor cars and

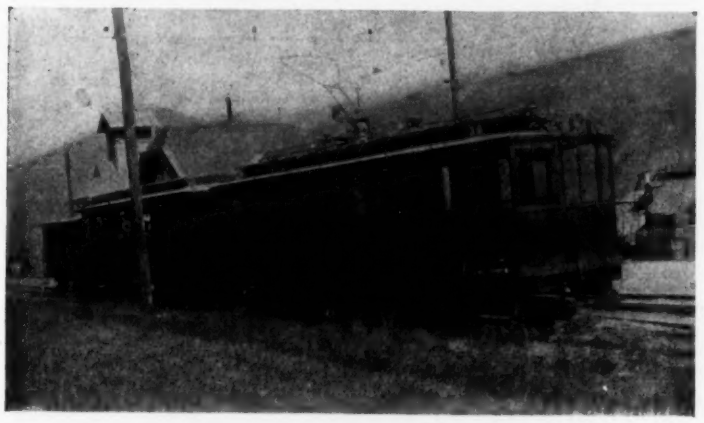


FIG. 3.—STUBAI VALLEY RAILWAY.

trailers are equipped with grounded iron guard ribs about 18 inches apart. The operation of the road has been regular except for a time last winter when a heavy snowfall blocked the road for three weeks.

DU BORINAGE-VICINAUX.

This road, which is located in the southern coal regions of Belgium, near Mons, was opened for service last April. There are 20 km. of single track, consisting of two lines each 7 km. long and a connecting loop with cross lines. A length of 14 km. is being operated at the present time, 5 cars being used. The completed equipment will include 20 cars. A striking feature of the installation resides in the use of a frequency of 40 cycles, the current being obtained from a combined lighting and power plant containing three-phase, 6,600-volt generators.

Each car is equipped with two 40-hp Winter-Eichberg motors.* The motors are designed for six poles. There are six brush holders, each containing three brushes 42 x 7 mm. The air-gap is 2 mm. on each side. The armature winding is series connected, one turn per coil. There are 134 commutator segments, each of greater width than the brush. There are 28 field turns per pole, made up in two separately-insulated coils. Each motor weighs 1,200 kg. without gears.

The trolley electromotive force is 600 volts. Two wires are used to avoid telephonic disturbances. The wires are placed 90 cm. apart and are suspended 6.5 meters above the rails. The poles are spaced 35 meters apart, the wires being held by a bracket construction with insulated span wire and hanger, giving double insulation. Guard wires are used to a considerable extent. Since being placed in service on April 6, 1905, the motors have given very little trouble. The commutators have blackened somewhat, but the insulation has not been impaired. The contacts in the controllers have as yet not been renewed. Those for the stator show scarcely any effect of burning, while the rotor contacts will soon need renewal.

ROME-CIVITA CASTELLANA.

This road is being equipped with compensated single-phase motors by the Westinghouse Company. The line is about 33.5 miles in length. Between Rome and Pont Milvio, a distance of 2.5 miles, the trolley e.m.f. is 550 volts. For the other part of the line the e.m.f. is 6,600 volts impressed directly upon the trolley wire. Each car is equipped with two 40-hp motors designed for 250 volts, 25 cycles. Each car carries one main transformer for primary pressures of 500 and 6,000 volts, and for a secondary pressure of approximately 250 volts; reversing switch; motor cut-out; a complete Westinghouse air-brake equipment, and one bow trolley for high pressure, operated by compressed air. The high-voltage trolley wire is suspended from span wires held on iron side brackets. Double insulation is provided. Two special porcelain insulators, which are fixed to the bracket arm by means of two bolts, are tested with 20,000 volts. Between these insulators is stretched the span wire, in which are inserted two strain insulators tested with 40,000 volts. The circuits at the station are so arranged that in case of short circuit on the line, or a break in the line, the current will be cut off at the same moment at the power station.

* We are informed by a letter which appears on page 701 that these motors are of the Latour type.

OERLIKON LOCOMOTIVE.

This locomotive is just being completed for test upon the experimental line owned by the Oerlikon Company, near Zurich. The line voltage will be 15,000, the frequency 25 cycles. There will be two 200-hp motors of the compensated series type, having eight main poles and eight commutating poles. There are two trucks, upon each of which is mounted a motor geared to a crank which drives through connecting rods. The motors are designed for a normal speed of 650 r.p.m. and an e.m.f. of 350 volts. Speed control is to be obtained by varying the voltage impressed upon the motor, 12 transformer taps being provided for this purpose. The shop tests have shown that the motors operate with 100 per cent overload without injurious sparking at the commutator.

The trolley collector which is proposed for this locomotive is of the special construction brought out by the Oerlikon Company. It consists of a rod about two feet long, which is held against the wire by spring pressure. Any extreme variations in the positions of the wire are followed by shifting the position of the carriage which supports the trolley wire.

VIENNA-BADEN.

This road is being equipped at the present time with Siemens-Schuckert single-phase motors for operation on both direct-current and alternating-current circuits. The road is 25 km. in length, and is double tracked for most of the distance. There will be 30 cars, each supplied with two 40-hp motors. A characteristic feature of the installation resides in the use of a trolley e.m.f. of about 500 volts throughout the whole route, frequent transformer sub-stations being placed along the alternating-current portion of the line between the two cities. It was considered preferable to select the same voltage for the whole system, in order to avoid complication of switching and control apparatus. The motors will be subjected to series-parallel rheostatic control.

HAMBURG ELEVATED.

This railway is being constructed by the German Government, contracts having been recently let to the Siemens-Schuckert Company for the power station equipment and to the Allgemeine Elektricitats Gesellschaft for the car equipments. There will be 50 cars, each supplied with three 120-hp Winter-Eichberg motors designed for 750 volts, 25 cycles. The trolley wire will be supplied with current at 6,600 volts, a transformer being used on each car to reduce the voltage for the motors. The motors are 4-pole machines, having an air gap of 3 mm. on each side, and are designed for a normal speed of 600 r.p.m. Each motor weighs 2,700 kg. alone, or 3,000 kg. complete with gears. The main transformer weighs about 1,000 kg. and the regulating transformers about 200 kg.

The total weight of the electrical equipment will be about 16.5 tons. Double cars, each having three axles, will be used. The weight of each unit with average load of 40 to 45 passengers is 75 metric tons. The total seating capacity of each double car is 140 persons. Each car will be equipped with two trolleys of the bow type. The overhead line will be of the catenary construction, using a grooved conductor of 80 sq. mm. in cross section and a single steel suspension wire 6 mm. in diameter. The conductor will be supported from the catenary at intervals of about 3.5 meters. The height of the conductor above the rail will be 5.5 meters normally, and 4.8 meters under bridges.

Each train will be made up of two or three double cars, controlled on the multiple-unit system. The circuits to the motors are opened between adjacent running points. The schedule speed is 27 km. per hour, with 15 stops, of 30 seconds each, approximately one-half mile apart.

The Cascade Converter.

We have had occasion frequently to refer to the cascade rotary converter, and an extended discussion of the theory of the machine may be found on page 230 of our issue for August 5, 1905. We are enabled to give below a detailed account of the design of a 7.5-kw machine which is now being exhibited at the Liege Exposition in the booth of the Ateliers de Construction Electrique de Charleroi. This machine is designed for the transformation of alternating into direct current. It partakes of the characteristics of a motor-generator and of a synchronous converter fed through stationary transformers.

The converting equipment is composed of two machines, which may be designated as the input and output machines, respectively. The input machine consists of a rotor and stator, similar to those of an induction motor. The output machine consists of armature and field structures, similar to those of a rotary converter. The rotor of the input machine is mounted on the same shaft with the armature of the output machine, and the rotor (secondary) winding is connected directly to the armature winding.

The electrical connections of the equipment are indicated in

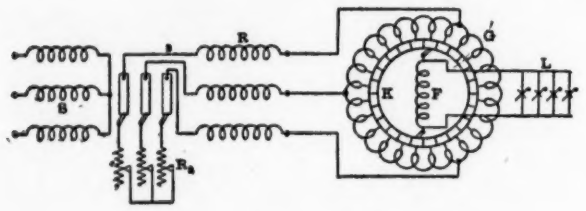


FIG. 1.—CIRCUITS OF CASCADE CONVERTER.

Fig. 1, which shows also the resistances for starting the machine as though it were an induction motor. *Ra* is the starting resistance, *S* is the stator winding (primary) and *R* is the rotor winding (secondary) of the first machine. *G* represents the armature winding of the output machine, *K* its commutator, and *F* serves to indicate its shunt field circuit, while *L* shows the load on the machine.

The operation of the equipment presents numerous points which are well worth mentioning. If it be assumed that the input machine has the same number of poles as the output machine, then the normal speed is equal to just one-half of the speed of the revolving field of the first machine (induction motor). Consider the action of the stator circuits of the input machine. When a certain alternating e.m.f. is impressed upon its terminals, the flux must have a value such that its rate of change produces a counter e.m.f. only slightly less than the impressed. When the primary circuits are symmetrically arranged and subjected to polyphase electromotive forces, the familiar synchronously revolving field is produced. This field cuts across the secondary conductors and generates therein electromotive forces having a frequency proportional to the slip from synchronous speed. The electromotive forces generated in the armature of the output machine, due to its motion through the constant field, will be proportioned directly to the speed. It is evident that these two polyphase electromotive forces will have the same frequency at a certain speed of the rotor, which speed will be one-half of that of the revolving field when the poles of the input and output machines are equal in number.

It is interesting to investigate the source of the power received by the output machine. A little study will show that the rotor reaches a definite speed at one-half of the speed of the revolving field, and that no change in "slip" can take place on account of the load, so that the ordinary phenomena connected with the performance of the polyphase induction motor is completely lacking. When current is drawn from the direct-current side of the output machine, a certain component of the power demanded is supplied by current which flows through from the secondary winding of the input machine. This current tends to alter the value of the core flux, and a counterbalancing component of current flows in the primary coil and restores the core flux to approximately its initial value. Thus a portion of the power is transmitted by transformer action. The current in the secondary produces a torque on the rotor due to the presence of the core flux, and hence a portion of the power is transmitted mechanically through the shaft by motor action. The ratio of motor action to transformer action is the same as the ratio between the number of poles of the input machine to that of the output machine.

In comparison with the ordinary rotary converter, the cascade converter possesses the advantage of operating at a lower frequency, and hence its commutation is much better. The input machine can be wound directly for any voltage, and hence step-down transformers are unnecessary. The makers claim that it is much lighter and cheaper than a motor-generator set. It is a synchronous machine, but can be started as a simple polyphase induction motor. It supplies its own exciting current, both during the starting period and during normal operation. On the input side its performance is similar in many respects to an induction motor operating at variable slip near synchronous speed, while on its output side it possesses the characteristics of a synchronous converter.

The constructional details of the machine exhibited at Liege are indicated in Fig. 2. It is designed for an output of 7.5 kw, at 230 volts.

The input machine consists of a three-phase, two-pole induction motor designed for 110 volts, 55.5 amp. per lead, 50 cycles. The dimensions of the stator are as follows:

Outside diameter, millimeters	430
Inside diameter, millimeters	230
Width of core, millimeters	110
Size of slots, millimeters	13 x 26
Number of slots	36
Conductors per slot	6

Each conductor is composed of three wires in multiple, each wire having a diameter of 3 mm. bare and of 3.3 mm. when insulated. The stator coils are connected in star.

The air-gap between the stator and rotor is 1.5 mm. The rotor speed is 1,500 r.p.m. and frequency 25 cycles. Its dimensions are as follows:

Outside diameter, millimeters	227
Diameter of shaft, millimeters	60
Size of slots, millimeters	8.5 x 30
Number of slots	42

There are 13 conductors per slot, each conductor being a wire of 3 mm. diameter bare and 3.3 mm., including insulation. The rotor coils are also connected in star.

The input machine is in reality a combined frequency converter and synchronous motor.

The generator resembles a three-phase, 25-cycle synchronous con-

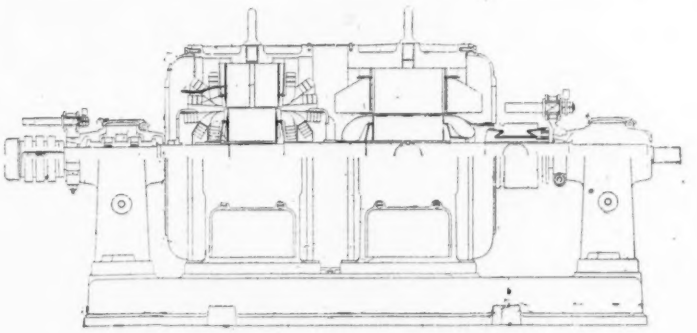


FIG. 2.—CONSTRUCTIONAL DETAILS OF MACHINE.

verter. It is a two-pole machine, designed for 250 volts and 32.7 amp. The dimensions of the armature are as follows:

Outside diameter, millimeters	190
Inside diameter, millimeters	65
Width, millimeters	160
Dimensions of slots, millimeters	7.5 x 19
Number of slots	45
Conductors per slot	12
Diameter of conductor, bare, millimeters	2.1
Diameter of conductor, insulated, millimeters	2.4
Diameter of commutator, millimeters	150
Useful length, commutator, millimeters	75
Segments, commutator	90
Number of brush studs	2
Brushes per stud	2
Size of brushes, millimeters	15 x 30

The dimensions of the field are as follows:

Diameter of bore, mm	196
Size of pole pieces, mm	175 x 155
Section of laminations, sq.. cm	160
Section of steel yoke, sq. cm	100
Turns in field coil	4000
Diameter of field conductor, bare, mm	.9
Diameter of field conductor, insulated, mm	1.1

The output machine is in reality a combined synchronous converter and a direct-current generator. Its power as a synchronous

converter is supplied from the frequency converter portion of the input machine, while the power to operate the direct-current generator part is derived from the synchronous motor portion of the primary machine. Neglecting the losses in the machine, it may be stated that one-half of the delivered direct-current power is transmitted through the machine on account of the frequency converter-synchronous converter features, and the remainder of the power is due to the synchronous motor-direct-current generator features.

Congress of Swedish Engineers.—I.

BY ARVID WESTERBERG.

THE first General Congress of Swedish Electrical Engineers, held in Stockholm September 9 to 11, was opened by the chairman of the organizing committee, Mr. C. Rossander, who expressed his satisfaction that the electrical engineers of Sweden had so largely responded to the invitation to this congress. The number of the members was between 250 and 300.

The officers of the congress were elected as follows: President, Professor K. Wallin; vice-presidents, Messrs. C. Rossander and S. Edström; secretaries, Messrs. A. Westerberg, K. G. Sjöberg and A. W. Nordell, all of Stockholm.

The first discussion of the meeting was on the subject "What has been the experience up to the present with the new Government laws and regulations relating to electrical engineering." Mr. C. Rossander read the introductory paper on the subject, and pointed out that with a few exceptions the new laws and regulations had proved to be of great benefit to the electrical engineering profession and industry. Still some changes would be very desirable. The present law prescribes that anyone who wishes to build an electric line whose voltage exceeds 250 volts has to apply for governmental permission, and that the application shall contain a list of owners of the ground within a distance of 500 ft. This distance Mr. Rossander considered to be much too great and an effort should be made to have it reduced. In some cases permission is also prescribed for low-tension lines, which regulation should be canceled. Further, it is desirable to bring about more rapid action on applications for authority. The following discussion proved that the majority of the members of the meeting agreed with Mr. Rossander, and the meeting passed a resolution adopting his proposition on the first two points named.

The next discussion was on high-tension work. Mr. Victor Ericsson read a paper treating the subject generally, and Mr. Sven Norberg in a paper discussed insulation and rise of potential. The first paper dealt principally with high-tension arrangements in the power house. The oil switch and its combination with overload relays and reverse current relays, momentary or with time limit, were discussed and also the question of fuses vs. automatic switches for high-tension work. The latter were, according to Mr. Ericsson, to be preferred in most cases. The main point of Mr. Norberg's paper was his treatment of rise of potential. He classified this phenomenon according to its cause, under four heads, as follows:

(1) Simple resonance at the third, fifth or higher harmonic wave of the main voltage and the natural frequency of the line, as defined by its self-induction and capacity.

(2) Sudden changes of the amperage in the line whereby there is a rush of electricity, swinging with the natural frequency of the system.

(3) Sudden changes of the potential of the line whereby the charge of current produces results similar to Class 2.

(4) Uneven distribution of potential in the different layers of the windings of transformers, generators or motors.

Mr. Norberg believed that the rise of potential coming under Class 1 might put a limit to the possible distance of electrical transmission of energy, and that the phenomena of Class 2 are likely to put a similar limit to the quantity of energy to be transmitted.

As to devices to prevent rise of potential, it is a good scheme to use starting rheostats in throwing in long lines or large transformers and motors. Still, it is hardly possible at present to prevent rise of potential and therefore protection against it is necessary. Mr. Norberg gave some hints for selecting lightning arresters and other protective devices against abnormal potentials. As a good protection against high potentials under Class 4, he mentioned Thomas' static interrupter.

In the following lively discussion the advantages of the oil switch in preventing rise of potential at throwing in and out of lines were set forth. With it the current is broken when the curve of the current passes through zero and no abnormal potential of Class 2 is likely to arise. One speaker pointed out that there is one important cause of rise of potential that was not mentioned by Mr. Norberg, namely, the existence of a spark-gap somewhere in the machine or in the line. This cause, he believed, was the most common one and the one that made most mischief. The influence of atmospheric electricity in weakening the insulation and causing secondary rise of potential was mentioned by one speaker who had made observations in this connection and had found that transmission lines running through forests were less seldom damaged by abnormal potentials than lines more exposed. Some theoretical points on rise of potential were also introduced in the discussion.

The next discussion was on the subject: "Running in parallel of water power stations at great distances from each other." The introductory paper was read by Mr. E. Andreen. Running in parallel of such stations may be by two methods depending on where the load is located. Either there may be one center of distribution to which point all stations transmit power by separate lines, or all stations are combined with one transmission line along which the different consumers are located. As they may use the current at different times, this case is analagous with the case of a moving load, for instance, of a train running along a line fed by power stations at different points. Mr. Andreen first treated the direct-current problem and then that of alternating-currents. In this latter case all the generator shafts must run in synchronism, as if all the shafts were rigidly coupled with each other. Assuming a straight regulation curve for the turbine governors, or in other words, that the decrease of speed is proportional to the output of the generator, the consequence is that every turbine of the whole system will, at a certain moment, have an output that is proportional to its size independent of the location of the load or the resistances of the line. Therefore, assuming that all the power stations of the proposed Swedish electric railway system were running in parallel, and that a train was starting in Norrland, the northern part, then the southern power station would take part in the delivery of current to this train in the same degree as the station next to the train. Of course very little of the energy sent out from the southern station would reach the train and therefore this system would not be very economical. It has also another disadvantage, namely, the danger of the generators falling out of synchronism, resulting from the enormous wattless currents that would arise.

In order to investigate those Mr. Andreen introduced a new generator characteristic which he named the "V-curve at constant field current." If two generators are running in parallel and one of them has a given output and constant field current, and if further, the voltage of the other one is varied, the voltage of the first generator must follow whether this generator receives lagging or leading wattless currents. If the armature current is plotted as a function of the voltage, a curve of the same general shape as the usual V-curve results. This curve can easily be figured out from the electric data of the machine. From this curve the wattless currents in a system like the above mentioned can be figured. In order to make a system like this practicable, it is necessary to adjust the turbine regulators, at different periods of the day, according to the location of the load at each period. Mr. Andreen suggested the substitution for one large system in parallel many smaller ones combined with double rotary converters for reserve. By means of a booster between these, one could at will throw parts of the load on one system or on the other. The following discussion treated principally of the question of paralleling the water power stations for the proposed Swedish Electric railway system. The difficulties of operating very great districts in parallel were acknowledged and some remedies were proposed. One speaker suggested to make the connections so that each station could be synchronized with either one of its neighboring stations, and to cut up the whole system in smaller ones, each consisting of only two stations. The advantages of using asynchronous generators for large systems in parallel were also set forth.

The next subject for discussion was on: "Lease of electrical power from water power stations." The introductory paper was read by Mr. T. F. Holmgren. It is often the case that a town desires to lease a certain amount of electric power for its pumping stations and its electric central stations. In such cases it is often impossible to tell in advance what amount of power will be necessary and, therefore, the contract is often based on the maximum power consumed. In order to measure this amount one may use different instruments, the two principal types being recording wattmeters and maximum demand wattmeters. The recording wattmeters have some disadvantages; they are not very accurate and sometimes quite momentary overloads are registered similar to overloads that have lasted for a certain time, depending on the thickness of the ink line. Mr. Holmgren described some maximum-demand wattmeters that are in use in Sweden—the Wright meter and the A. E. G. "maximum tariff meter"—but thought that none of them quite corresponds to the requirements of an up-to-date meter. After some words about the guarantees that the power station ought to give regarding voltage and frequency, and those that the consumer should give regarding power factor and uneven load on the three phases, Mr. Holmgren spoke about the price that ought to be charged for electric power. He compared this price with the producing cost of steam power and gave some curves of this cost for different sizes of plant and different working hours of day. The following discussion treated principally the question of recording vs. maximum-demand wattmeters, and the cost figures, given by Mr. Holmgren. Some new types of maximum-demand meters were also described, including one constructed by Hartmann & Braun that indicates the maximum that the consumed energy has reached during each load period. This instrument has the advantage of being very simple and cheap. Another instrument registers the number of kilowatt-hours of the peaks of the load above a certain value; the consumer is charged a fixed price for this amount of energy, and for the remainder has to pay according to the usual meter rate.

Recent Electrochemical Developments.

ELECTRIC FURNACES.

For the production of carborundum, artificial graphite and siloxicon in the electric furnace intermittent processes are used. To make a run the furnace is built up, the charge material being piled up within walls of loose bricks. The highest temperature is in the center of the charge and the walls serve merely to keep the charge in position. After the furnace run is completed, the walls are torn down. This has heretofore been done by hand labor, one brick at a time, and the same was the case with building up the furnace.

A recent patent of F. J. Tone, of the Carborundum Company, points out that this repeated handling of bricks is the cause of considerable expense and difficulty and may be easily avoided by constructing the furnace walls in form of iron frames in which the bricks are permanently assembled. These frames are put in place or withdrawn by means of cranes.

A recent patent of F. J. Machalske refers to the treatment of compounds of calcium in an electric furnace when subjected to the action of methane or natural gas. The reaction results in the production of the hydride with by products. If for instance calcium chloride is treated with methane, the by products are chlorides of carbon.

ELECTROLYTIC PROCESSES.

For the electrolysis of chlorides of alkalies—which represents one of the largest electrochemical industries for the production of caustic and bleaching powder, hypochlorites and chlorates—anodes of graphite and platinum are now very largely used. In a recent patent of H. Specketer it is proposed to use electrodes made from ferric oxide. Ordinary oxide of iron—which is available at a low price—may be used for this purpose. It is fused in an electric furnace and the molten mass is drawn off into properly shaped moulds.

Quite a number of patents relating to electroplating apparatus have recently been granted. Two patents of Meaker refer to a method and details of construction of a tank for coating a wire with zinc. A patent of L. Potthoff relates to details of a cell for galvanizing bars, tubes and other pieces too large to be shaken up as is done with small nails. That indefatigable worker and inventor in metal deposition, Mr. Sherard Cowper-Coles, produces metallic strip or wire by electrolytic deposition in the following way: He uses a cylindrical cathode, around the periphery of which a very fine groove is described in form of a helix. When the desired thickness of metal has been deposited, the cathode is removed from the cell and the metal deposit can then be wound off with facility in the form of a spiral, the metal parting along the groove.

LETTERS TO THE EDITORS.

How Can the Ball Roll?

To the Editors of Electrical World and Engineer:

SIRS:—Some years ago an advertiser claimed that neither wheel need slip in going around a curve, even though they were attached to the axle, provided that axle could take up a position radial to the curve. Now, I should like to ask with reference to the enclosed sketch and description, "How can the ball 'roll'?"

"The lower end of the shaft terminates in a ball and cup bearing, the ball being hardened steel, the bearings sapphire jewels.

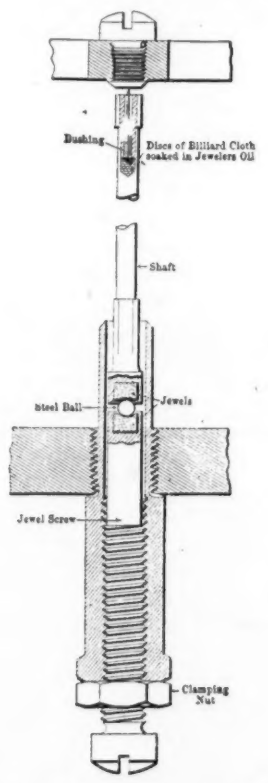


DIAGRAM OF ARRANGEMENT.

It will be readily seen that the shaft resting perpendicularly upon the ball, turns with the least possible frictional resistance, and that the ball rolling, lightly between two highly polished sapphire jewels, at half the speed of the moving element, constantly presents new contact points on both ball and jewels, so that even after long service no wear is perceptible."

I can see how it can spin or revolve upon the same constant axis as the rest of the moving parts, but how can it roll?

NEW YORK CITY. WILLIAM HALLOCK.

Wireless Telegraphy in Mexico.

To the Editors of Electrical World and Engineer:

SIRS:—We note in your esteemed paper of August 26, No. 9, page 340, the following item:

"Wireless in Mexico. It is designed to establish wireless telegraphy in various parts of Mexico, using the Marconi system. Camilo Gonzalez, who is general manager of the Mexican Federal Telegraph Company, will have charge of the installation. The first system will probably be installed in the State of Chihuahua, while

other stations will be erected in Jalisco, Tepic, Sonora, Sinaloa and Nueos Leon."

According to information received from our own representative in Mexico, the state of affairs is quite different. The Marconi Company had sent their agent from London to Mexico, with the intention to show their system to the telegraphic authorities. The general directors of the Federal telegraph assured our representative that no order had been given to the Marconi company. The above mentioned article, however, is written in such a way that one may get the impression that orders for apparatus had been given already.

BERLIN, GERMANY. GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE.

Belgian Single-Phase Railway.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of September 2, 1905, appeared an abstract of an article by Dr. Dietl, describing a single-phase railway in Belgium, in which it was stated that Winter-Eichberg motors are used on this line. I want simply to remark that according to an agreement made with the Allgemeine Elektricitäts Gesellschaft, of Berlin, two years ago, the single-phase motors of that line are considered to be built under my Belgian patents.

SCHENECTADY, N. Y. MARIUS LATOUR.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Commutation Poles.—FRIEDLANDER.—An illustrated article on direct-current machines with commutation poles shown at the present Olympia electrical exhibition in London. Such machines are exhibited by the Phoenix Dynamo Manufacturing Company, by the Morris-Hawkins Company, by the British Electric Plant Company, and by Lahmeyer. The latter company exhibits a variable-voltage, direct-current booster with rectangular commutation poles placed midway between the main poles and extending over the whole length of the armature. Each commutation pole is excited directly by the current of the set of brushes which it influences. In most cases the peripheral span of the commutation pole is made from 1.5 to 3 times the slot pitch. The use of a very narrow pole piece, although sufficient for commutation purposes, is not advisable since according to Breslauer such poles are liable to be set into violent vibration by the changes of flux which occur as slots and teeth alternately pass opposite the pole. The author thinks that commutation poles or some equivalent arrangement will shortly become the rule rather than the exception, especially for higher voltages (over 250 volts) and speeds.—Lond. *Elec. Eng.*, September 29.

Dynamo.—WINKELMANN.—Some notes on a dynamo built by Dittmar. The special feature is that the magnetic flux is not perpendicular to the direction of the axle in the armature, but is essentially parallel to the axle. The construction is shown in Fig. 1.

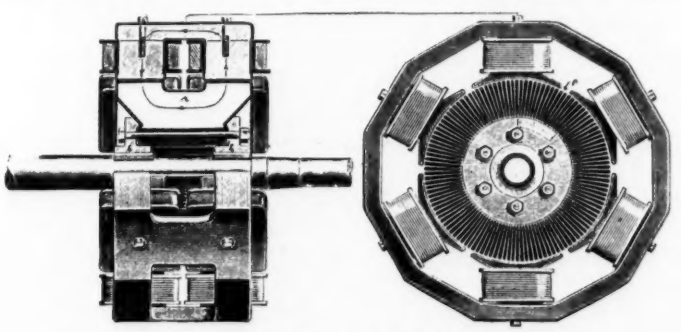


FIG. 1.—DITTMAR DYNAMO.

The iron sheets are put together in packages, each package being pressed together by two end discs. Betwen the different packages wedged-formed air spaces are left which are filled with the armature wire. The field magnets are arranged in pairs in such a way that their yoke is parallel to the axle. Opposite to an armature sheet there is, therefore, on one side a north pole and on the other side a south pole. The latest types of these machines are stated to have a capacity 1.5 or 2 times the capacity of machines of normal construction. A motor of 50 hp constant capacity has a maximum diameter of casing of about 720 mm., its weight is 668 kg., the efficiency 85 per cent, the number of revolutions 650 at 220 volts. Of the active material, the armature copper weighs 40 kg., the commutator copper 46 kg., and the field magnet copper 50 kg.; hence the total weight of copper is 136 kg. The armature iron weighs 170 kg., the field magnet iron 225 kg., hence the total weight of active iron is 395 kg. The intention is to apply the same construction to alternators and induction motors, and it is expected that the latter will show a good power factor.—*Elek. Bahnen*, August 4.

Calculation of Transformers.—POHL AND BOHLE.—A mathematical article illustrated by diagrams in which the authors give rules for calculating a transformer, if the capacity, the primary and secondary voltages, the frequency and the efficiency are given. The calculation is based on the endeavor to design the transformer so that the price of the material needed in it becomes a minimum. The authors show for the case of the single-phase core-type transformer that this result can be accomplished without long, tedious calculations.—*Elek. Zeit.*, September 28. The first part of the same article in English in Lond. *Elec. Eng.*, September 29.

LIGHTS AND LIGHTING.

Calculations of Mean Spherical Candle-Power.—WILD.—An account of a method by which the mean spherical candle-power of an ordinary incandescent lamp can be calculated with an error not greater than ½ per cent from measurements taken at angles differing by 30°. It is not pretended that measurements every 30° would suffice in the testing of an arc lamp, for example, nor any source of light the candle-power of which undergoes great changes over small difference of angle, but for ordinary incandescent lamps the mean spherical candle-power calculated from measurement at every 30° should be sufficiently accurate for all ordinary purposes. The method is simply to multiply the measured values of the mean circular candle-power at angles of 0, 30, 60 and 90° above and below the horizontal with certain factors, and to add all products together, which gives directly the mean spherical candle-power. These multiplying factors with which the circular candle-power at different angles is to be multiplied, are as follows:

	Multiplying factor.
Angle 90 deg. above horizontal	0.017
" 60 " " "	0.1295
" 30 " " "	0.224
" 0 " horizontal	0.259
" 30 " below horizontal	0.224
" 60 " " "	0.1295
" 90 " " "	0.017

The author also gives the multiplying factors for measurements of the mean circular candle-power every 15° and every 10°.—Lond. *Elec.*, September 29.

Fittings.—The first part of an illustrated article on some new designs in electric light fittings shown at the Olympia Electrical Exhibition in London.—Lond. *Elec. Eng.*, September 29.

POWER.

Italian Power Transmission.—Some notes on the hydro-electric plant at Cellina from which electric energy is transmitted to Venice, a distance of 90 km. The generating station contains six turbines, driving directly three-phase alternators of 1,800 kw, giving 1,000 volts at a frequency of 50 periods per second, the speed being 315 r.p.m. Three 130-kw, direct-current sets give the exciting current; 15 single-phase transformers of 1,000 kilovolt-amp. raise the voltage to 36,000 for transmission. These transformers are arranged in groups of three and connected in delta fashion. Later on, if extensions necessitate it, they may be connected in star fashion so as to give a voltage of 50,000. The potential difference at Venice is maintained constant at 27,000 volts. Four groups, each of three transformers furnish current to the transmission line; the fifth group is held for reserve and may be connected to any of the lines. Each transformer is provided on the primary as well as secondary circuit with an automatic circuit-breaker, and across the primary terminals Wurts lightning arresters are connected. The transformers are also provided with thermostatic devices which light a red lamp on the switchboard if the increase of temperature should

be above 40° C. The transmission line consists of four groups, each of three wires, of 53 sq. mm. cross-section. At Venice the e.m.f. is reduced by transformers first to 6,000 volts and then to 205 volts for the new distributing network and to 2,000 volts for the old one.—*L'Eclairage Elec.*, September 9.

Power Distribution on the Rand in South Africa.—HAMMOND.—A paper presented before the British Association at Johannesburg. The author points out that lately power distribution schemes have been devised in England in places where no water power is available, but where economy in the cost of generation from aggregation of output in one huge power station is relied upon. So markedly is the economy attained that the "most progressive of the English Railway Companies," the Northeastern, has found it actually more economical to draw its supplies of electrical energy for the working of 39 miles of railway from a central power distribution company than to erect its own generating plant. The author is impressed with the fact that in such a dense industrial area as that included in the Witwatersrand power distribution undertakings of magnitude are not in operation. He endeavors to show that the working of the mines could be cheapened by the greatly extended application of electric power. Those who are at present using only steam power would find an economy in adopting electric power. Whether the electric power should be produced by each mine or group of mines installing its own plant or by means of centralization of generation in plants serving a number of mines, is purely a commercial question. The author gives in detail estimates of the cost of one big central station with two sub-stations on the East and on the West Rand. In the discussion Jennings said that electric winding is undoubtedly convenient and safe and cheap, but steam could be used much more economically than at present by adopting continuous haulage. Siemens said that the load factor is more important in diminishing the cost of production than the size of the generating units. As the load factor of each mine is already very high (0.5 or more), no great saving could be obtained by the establishment of a single central station, and separate stations have some advantages.—Lond. *Elec.*, September 29.

Magnetic Clutch.—In an article on the electrical exhibition at Olympia, is described a magnetic clutch of Holden, which is applied to an electrically-driven cream separator. The principal advantage is that it renders countershafting unnecessary. The Holden clutch, as shown in Fig. 2, is of very simple character, consisting

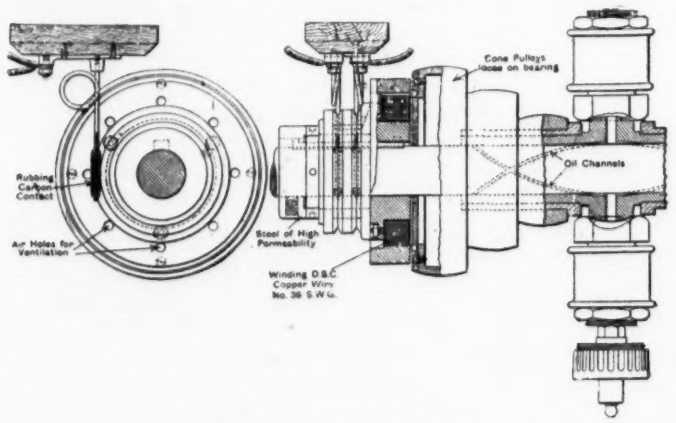

Cone Pulleys loose on bearing
Oil Channels
Rubbing Carbon Contact
Air Holes for Ventilation
Steel of High Permeability
Winding D.S.C. Copper Wire No. 36 S.W.G.

FIG. 2.—MAGNETIC CLUTCH.

of a thick disc of wrought iron or of high-permeability cut steel, keyed on the main shaft and having an annular groove into which the magnet coil is placed. The ends of the coil are connected to two grooved rings insulated from each other, current being conveyed to them by carbon contacts. A soft wrought-iron plate is fixed to the pulley which it is desired to drive. Between the magnet face of the disc and this plate a thin steel disc is placed to prevent the adhesion of the two iron faces due to residual magnetism when the current is cut off. Where cast-iron swiveling bearings are used, the pulleys can be very conveniently arranged to revolve on the outside of the bearing. By mounting the step cone on a sleeve the main shafting is relieved entirely of carrying the weight of the pulleys, which not only reduces the bearing friction, but also avoids the friction of loose pulleys on a running shaft when not in use. In a modified form the clutch is used for holding articles to be ground or turned as a holder for portable drills, etc. It is said that the power required by the clutch does not exceed 3 watts per hp transmitted and it can be obtained from the ordinary direct-current lighting circuits.—Lond. *Elec.*, September 29.

Power Distribution.—GAMLEN.—A paper read before the British Institute of Mining Engineers on "Up-to-date Electrical Power Distribution." The author compares gas engines with steam turbines in favor of the latter and deals with power distribution by means of high-tension, three-phase currents.—Lond. *Elec.*, September 15.

Steam Turbine Plant.—A long and fully-illustrated description of the new steam turbine power plant of the Detroit Edison Company, which has an initial rated capacity of 12,000 kw.—*Eng'ing Record*, October 7.

Metallic Packings.—STROHM.—An illustrated article describing the various types of metallic packings used in connection with steam engines.—*Am. Elec.*, October.

TRACTION.

Roller Bearings.—How.—A paper presented before the British Associatiton. The author states that recent tests on line shafting, electrically-driven and fitted with roller bearings, effected a saving of 24.4 per cent of the power required to run the motor and countershaft with machines in full work. In tramway and railway vehicles the author states that a series of tests has also proved the "starting effort" to be 3 pounds per ton of load, corresponding to a saving in electrical energy equal to 50 per cent of journal friction, equivalent to 1 per cent per car-mile. On the Birmingham electric tramways a saving of 24.3 per cent of tractive force per ton of load was attained; and at Southport the average energy consumption by roller-bearing cars was 0.55 kw-hour per car-mile, with a mean speed of 10.3 miles per hour, as against 1 kw-hour per car-mile and a mean speed of 8.6 miles per hour. In the discussion of the paper Bayley-Marshall said that the reference to the Liverpool Overhead Railway was to some experiments that he had carried out to see if it were at all possible to increase the carrying capacity of the railway. The net result was that they were now able with roller bearings to run a three-car train with one-minute service, as against a two-car train using ordinary bearings. Godwin said the life of roller bearings was about 10 years, but this life would be much shortened by the sand and grit inherent in tramway work. Beare asked if the difficulty of parallelism in the rollers had been solved. Bayley-Marshall replied that with rollers made as parallel as was possible by human hands, "crossing" yet took place. He thought, however, that the "floating-cage" method, in which the rollers were rigidly gripped, had really overcome the difficulty.—Lond. *Elec.*, September 15.

Railway Signals.—HAMILTON.—Notes on signaling on the Cape Colony railways.—Lond. *Elec.*, September 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Insulated Versus Bare Neutral Wire.—ERENS.—For three-wire systems the Association of German Electrical Engineers laid down the rule in 1899 that the neutral wire must be earthed and that no fuse should be inserted in it. Later on it has become practice to place the bare neutral wire without insulation in the earth, and it has been claimed that this method is cheaper, causes less troubles in telephone lines, gives a greater guarantee of safety of service and yields a better balancing of voltages if the two halves of the network are unequally loaded. The author discusses these arguments and shows that with the use of the bare neutral wire the saving in first cost is small in comparison with the total cost. With respect to telephone disturbances he claims that the bare neutral wire has no advantage over the insulated metal wire. With a bare metal wire one is not sure that there will be no disturbances due to the earthing of the outers. If the insulated neutral wire is properly dimensioned it is possible to prevent any large disturbing voltage difference in the two halves of the network in the same way as is the case with a bare metal wire. On the other hand, the insulated neutral wire has the following advantage. If in a cable network with a bare neutral wire, a small earth, say, of 20 amp., occur, such losses of current cannot be detected at all, since this stray current does not differ in any way from the current paid for by consumers, both currents passing from the outer to earth. If, however, the neutral wire is insulated and earthed at the station, it is easy to watch continually the insulation resistance of the network. It is only necessary to insert an ammeter in the earth connection of the neutral wire. If then, at any place of the network, an earth occurs on an outer, then (if the balance of the cables are in good condition) the earth current must pass through the ammeter. If the

ammeter is placed on the switchboard the attendant will see at once whether the cable network is in good condition. The only objection to this method is that if on both outers a ground occurs simultaneously, only the difference of the two currents corresponding to the two earths will pass through the ammeter, and if by chance the two earths on the two outers should be equal no current will pass through the ammeter. However, it is easy to determine the insulation resistance of each outer by the following simple means: In Fig. 3 K_1, K_0 and K_2 represent the positive, neutral and negative

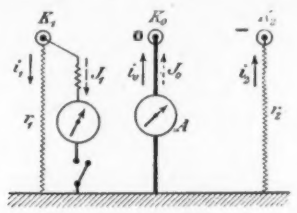


FIG. 3.—INSULATION TESTS.

cables of the three-wire network; $r_1 r_2$ are the insulation resistances of the outers which are to be determined. The neutral wire, K_0, is connected to earth by means of a large copper conductor, in which the ammeter, A, is inserted. The ohmic resistance of this earth connection can be made negligibly small. If there occurs an earth on each outer the currents passing on this account between the two outers and earth may be i_1 and i_2, respectively. Then only their difference, i_0, will pass through the ammeter, A. If now the voltages of the two outers against earth are measured and found to be P_1 and P_2 one has the three equations: First, $i_0 = i_1 - i_2$; second, $P_1 = i_1 r_1$; third, $P_2 = i_2 r_2$. The author then connects one of the outers, for instance, the positive one, through a resistance to earth. The current which will pass through this connection into earth may be J_1, while simultaneously the current, J_0', is measured in the ammeter, A, and the voltages of the outers against earth are also measured; they may be P_1' and P_2'. The earth currents have now different values. They may be i_1' and i_2', while r_1 and r_2 has the same values as before. This gives three more equations, namely, fourth, $J_0' = i_1' + J_1 - i_2'$; fifth, $P_1' = i_1 r_1$, and sixth, $P_2' = i_2' r_2$. In this way there are obtained six equations for the determination of the six unknown values, r_1, r_2, i_1 i_2, i_1' and i_2'. It is thus easy to determine the insulation resistances, r_1 and r_2, and it is thus always possible to find whether the current measured in the ammeter in the earth connection of the neutral wire indicates an earth in one outer or the difference of earths in the two outers. In this way it is very easy to watch continually the insulation resistance of a three-wire network. This is not possible with bare neutral wires.—*Elek. Zeit.*, September 28.

Automatic Starters.—A note on several types of automatic starting rheostats with liquid resistances. A starter of Lahmeyer, which is specially adapted for large motors driving pumps, compressors and lifts, acts in the following fashion: A lever is operated by a to-and-fro movement and a catch which engages with the inclined teeth of a sector produces the revolution (one notch for each period) of the axle which operates the rheostat. The lever is acted upon by an electromagnet. In this way the starting of the motor goes on slowly, while the breaking of the circuit is sudden. Another starter consists of two discs driven by the motor itself. One of the discs revolves with the same speed as the motor, while the second disc is so geared that it revolves at a slower speed. The second disc produces the progressive starting of the motor while the first disc opens the circuit. The coupling between the discs and the motor is produced by means of an electromagnet. A starter which has the advantage of giving a very progressive increase of the current consists of two containing vessels, one above the other, the higher one containing the electrodes for the starting resistance while the liquid is contained in the lower vessel. When the circuit is closed an electromagnetic device forces a plunger to drop into the liquid which thus gradually rises.—*L'Eclairage Elec.*, August 19.

Electricity in Collieries.—WALKER.—A paper read before the (Brit.) Inst. Min. Eng. and discussing in detail the rules of the British Home Office tending towards the protection of workingmen in mines from shock and towards the prevention of earths in collieries.—Lond. *Elec.*, September 15.

High-Tension Circuit-Breaking Devices.—FERNANDEZ.—An illustrated article describing in detail the operating mechanism of high-tension oil switches, together with diagrams of their connections. —*Amer. Elec.*, October.

WIRES, WIRING AND CONDUITS.

Dielectric Strength of Insulating Materials.—SYMONS.—A communication with reference to the recent article of Kinzbrunner. The author points out that it is important to find out why a dielectric breaks down under a high voltage stress; whether the break down is a mechanical rupture produced by voltage stress or is due to the fact that as the voltage increases (Ohm's law holding good) the dielectric conducts more current, until it becomes unable to dissipate its heat so that the material is charred and breakdown occurs. In the case of material such as porcelain, glass and mica if the circuit be broken as soon as the material is punctured the breakdown seems to be the result of mechanical rupture. Especially is this so in the case of mica. To compare materials of different manufacture, in addition to time tests, he designates that voltage which produces puncture immediately upon application as the "disruptive voltage" the circuit being closed on the high-tension side of the transormer. This definition has been found to give satisfactory results, and moreover, with materials of uniform quality, nearly straight line laws result for the ratio between thickness and dielectric strength.—Lond. *Elec.*, September 29.

Cement Foundation for Wooden Poles.—HERZOG.—An illustrated description of the system of Kastler who puts a cement foundation into the earth and mounts the wooden pole within this foundation in such a way that the lower end of the pole is above earth and cannot come into contact with the moisture of the earth. The pole is fixed into the foundation by means of lateral iron rods so that there is an air space of several centimeters between the cement and wood. The system is claimed to result in a great saving in the maintenance of wooden poles.—*Zeit. f. Elek.* (Vienna) September 24.

Telephone Cable.—An illustrated article on a telephone cable which has recently been placed in Lake Como in Italy. It is laid in water about 460 ft. deep. It has two conductors, each consisting of seven tinned 0.55 mm. (0.0217 in.) copper wires, the copper section of each conductor, therefore, being 1.66 sq. mm. (0.00257 sq. in.). Each conductor thus formed is covered with three layers of guttapercha, bringing the diameter up to 6 mm. (0.236 in.). Both conductors are then filled in and covered with hemp, so as to bring the diameter up to 17 mm. (0.67 in.). On top of this are 18 galvanized iron wires (2.5 mm. = 0.1 in. in diameter), covered by impermeable tape, tarred tape and finally "Clark" compound. The second armoring of the shore ends (where the cable is strengthened), consists of 18 galvanized iron wires, 4.5 mm. (0.177 in.) diameter, and the final covering is composed of two layers of tarred tape, the whole being well impregnated with "Clark" compound. According to the specification, the capacity of one conductor (the other being connected to earth) was not to exceed 0.306 microfarad per mile, the maximum resistance of the conductor at 15° C. was not to be more than 11 ohms per mile, and the insulation resistance between one conductor and the other conductor—which was to be earthed —was to be not less than 620 megohms per mile at a temperature of 24° C. On the test the capacity was found to be 0.292 microfarad per mile, the ohmic resistance 10.2 ohms per mile at 15° C., while the insulation resistance came to 806 megohms per mile at 24° C.—Lond. *Elec.*, September 8.

ELECTROPHYSICS AND MAGNETISM.

Joule-Thomson Effect.—KESTER.—The original Joule experiments, the aim of which was the determination of the amount of work done against the forces of intermolecular attraction when a gas expands without doing external work, were performed in 1844. Joule then devised the porous plug form of apparatus. This same arrangement has been used by the present author to study the effect in carbon dioxide. In the present installment the experimental part of the investigation is given.—*Phys. Rev.*, October.

Electric Wind.—JANUSZKIEWICZ.—A description of an experiment showing that a stream of electrified gas proceeding from a charged fine point is stronger if the point is negatively charged than if it is positively charged. In other words, the negative wind is the stronger.—Lond. *Elec.*, September 29; *Phys. Zeit.*, September 15.

ELECTROCHEMISTRY AND BATTERIES.

Acid Pickle.—BURGESS.—The conclusion of his article on the action of acids on iron and the use of the acid pickle. In the present

installment he discusses the uses of hydrochloric and sulphuric acid. —*Electrochem. and Met. Ind.*, October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Vertical Intensity Variometer.—VON BUEKY.—A description of an instrument for measuring the variations of the earth's vertical magnetic field more accurately than heretofore. The instrument consists essentially of an astatic combination of needles hung in a bifilar suspension at right angles to the magnetic meridian. A bundle of thin rods of soft iron is placed in a vertical position broadside on to the needles some distance away. The horizontal intensity has no effect upon the astatic combination nor upon the vertical iron rods. But the earth's vertical field induces a north-seeking pole in the lower end of the soft iron and a south-seeking pole in the upper end. These poles exert upon the needles near them magnetic moments in the same sense, and these moments are proportional to the vertical intensity. The author uses a special device to correct for temperature, in the shape of an auxiliary magnet mounted on the side opposite the soft iron and pointing towards it. It is turned in such a manner that its effect is opposed to that of the soft iron, and its distance is determined by calculation in such a manner that its change of moment balances the changes of moment of the other magnetic bodies. The nearer the compensating magnet is to the suspension the less sensitive is the variometer.—Lond *Elec.*, September 15; from *Phys. Zeit.*, September 1.

Quadrant Electrometer for Measuring Current.—STEWART.—A mathematical investigation with respect to the extensive use of the quadrant electrometer in radioactivity work. Since this use is generally limited to the measurement of small currents through some gas, the analysis of the author is restricted to this particular work. *Phys. Rev.*, October.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Measurer for Wireless Telegraphy.—FLEMING.—An account of a recent English patent for apparatus for measuring the

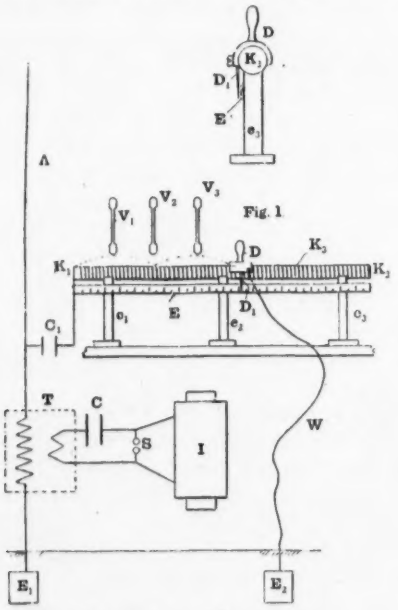


Fig. 1

FIG. 4.—WAVE MEASURER.

wavelengths in wireless telegraphy. The instrument consists of a long coil, K_1 K_2 (Fig. 4), of fine copper wire insulated with silk, which is wound in one single layer in closely adjacent turns on a rod, K_3, of ebonite, glass or other highly insulating material. This long helix is supported on insulating stands, such as e_1 e_2 e_3. C_1 is a small air condenser. On the helix, $K_1 K_2$, slides a metal saddle, D, padded with tin foil or other flexible metallic material to cause it to make good contact with the surface of the insulated spiral wire. This saddle is connected by a stout wire, W, with a good earth plate, E_2. The saddle, D, has an insulating handle and fits closely on the helix K_1 K_2. The transmitter may be of any usual type; that shown consists of an induction coil, I, which has its secondary terminals connected to a spark-gap, S, and the spark balls are connected by a condenser, C, with the primary coil of an air-core transformer, T, the secondary circuit of which is inserted between an aerial wire, A, and an earth plate, E_1. When the induction coil is in operation, electric oscillations of a certain frequency are set up in the aerial wire, A. To determine this frequency the saddle, D, is moved along the helix and tests are made with a small vacuum tube. The oscillations in the aerial wire act through the condenser, C_1, upon the long helix and set up in this helix stationary electric waves which travel along the helix with a certain velocity and are reflected at the saddle, D. If the saddle, D, is moved to such a position that the distance K_1D, is equal to one complete wavelength of a stationary potential wave upon the helix, then if we hold the vacuum tube above mentioned at the point, V_3, half way between K_1 and D, it will not be illuminated, because at that point the electric potential in the air near the spiral is extremely small, but if the vacuum tube is held at points, V_1 or V_2, which are respectively one-fourth or three-fourths of the way from K_1D, it will be brightly illuminated. If, however, the saddle, D, is placed at any other position which is not an exact wavelength or multiple of the wavelength, then there will be no such regular distribution of potential, but the vacuum tube will either glow or not glow irregularly in any position. The wavelength is read off directly from the scale E.—Lond. *Elec.*, September 29.

Trees in Wireless Telegraphy.—SCHMIDT.—A note on the use of trees as receivers in wireless telegraphy. He has found that in many kinds of trees certain parts of the limbs correspond to certain portions of the root from which they get their nutriment through channels having a smaller electric resistance than neighboring portions of the trunk. In using a tree for receiving wireless telegraphic messages it is preferable to make connection at such portions of the trunk which connect a strong root with the corresponding topmost branch.—*Elek. Zeit.*, September 28.

Financial End of Industrial Engineering.—DIXON.—An article in which the writer describes a method for arriving at the fixed charges on an engineering investment. While the methods used are applicable to all investments, the case of a power plant to be built is assumed.—*Iron Age*, October 5.

Earthing of Wireless Telegraph Aerials.—MONCKTON.—An account of experiments which taken together with those of others, make it appear that, at any rate for most land stations, an insulated lower capacity would be the best.—Lond. *Elec.*, September 15.

MISCELLANEOUS.

Insurance and Inspection of Electrical Machinery in Great Britain.—An abstract of the annual report for 1904 of the British Engine, Boiler & Electrical Insurance Company. The number of dynamos and motors insured at the end of 1904 exceeded the number insured at the end of 1904 by 20 per cent. On the other hand, the number of breakdowns of insured machines in 1904 exceeded the number in 1903 by 28 per cent. The claims made, therefore, have increased more rapidly than the insurance effected. The cause of this increase is not apparent, unless it be deterioration resulting from greater age. The rate of breakdowns among dynamos was 1 in 12, the rate among motors 1 in 9.3, excluding breakdowns of starting resistance switches, or 1 in 8.2, including them. Beyond question, many breakdowns are prevented by the periodical inspection given by the company, so that among insured machines the rate of breakdown must be still heavier. Some details are given.—Lond. *Elec.*, September 29.

Electrotherapeutics.—RENAULT.—A summary of the useful applications made of electrical treatments, more especially in the case of workmen's accidents. The author distinguishes direct applications, such as galvanization and faradization and indirect applications, working by the generation of light, heat or mechanical motion. Galvanization consists in the application of direct-currents of about 12 to 15 milliamperes for some 15 minutes, the negative terminal being applied to the diseased part. This process is valuable in muscular atrophy occasioned by contusions, dislocations or fractures, and in most diseases of the joints. The author has also found it efficacious in curing fistulæ occasioned by the careless handling of meat, using in this case a copper electrode inserted in the sore and reversing the current several times. "Faradization" is the treatment with alternating currents or with alternating currents superimposed upon continuous currents ("galvanic-faradization"). It is employed both in muscular atrophy and in natural anæsthesia. Other applications are those of alternating currents, high-frequency currents ("auto conduction"), sparking and galvano-cautery. An interesting application is the electric stimulation of muscles for the detection of simulation, the reaction being quite independent of the will of the patient.—Lond. *Elec.*, September 22; from *Archives d'Elec. Med.*, September 10.

Steam Turbines.—BILES.—A paper on steam turbines as applied to ocean liners, read before the British Association. The results of tests are said to "completely justify the adoption of the turbine in ocean liners."—Lond. *Elec.*, September 15.

BOOK REVIEWS.

L'ANNEE ELECTRIQUE, ELECTROTHERAPIQUE ET RADIOGRAPHIQUE. Revue de 1904. By Dr. Foveau de Courmelles. Paris: Ch. Beranger. 372 pages. Price, 3 francs 50.

This is a handy manual containing a general and succinct account of the progress made during the year in the various departments of applied science. Electrochemistry, electric lighting, heating and traction, take up 37 pages. The war in the Far East has afforded material for chapters on the international perfection of submarine cables as well as in some of the multifarious uses of wireless telegraphy in time of war. The influence of light of different colors on the human system is recorded, as well as the therapeutic value of currents of high frequency. The physical properties of radium and the uses made of this new element for the cure of some of the afflictions to which human flesh is heir, are dealt with in the compass of 28 pages.

On page 327 we find Loddy instead of Soddy; on p. 301 Ramsay is spoken of as having discussed helium in the Sun, whereas it was Frankland and Lockyer, who first noticed the helium lines in the spectrum of the chromosphere during the solar eclipse of 1868. Ramsay found the "hypothetical" element in terrestrial substances in 1895.

CAUSERIES SUR LE RADIUM ET LES NOUVELLES RADIATIONS. Par Georges Claude. Paris: Ch. Dunod. 132 pages, 44 illustrations. Price, 3 francs.

The title of this little book, "Causeries," indicates the popular style of exposition adopted by the author. If there is a tendency to verbosity, we must hasten to add that it is accompanied by clearness of expression and fullness of matter.

As the volume was written for the lay reader of contemporary science, it aims at giving only a general idea of the advances made in molecular physics during the past few years. The electric action of condensers is explained by means of hydraulic analogues; then follow the classic experiments of Hertz on electric radiation, and in due time the phenomena of X-rays, canal rays and cathode rays. The pregnant discovery of uranium rays by Henri Becquerel in 1896 is taken as marking the beginning of a new era in physical theory, and well it may as it prepared the way for the work of the Curies and the many gleaners in their field of research. M. Claude describes the phenomena of radioactivity with precision and lucidity; his book affords pleasant and instructive reading. Omitting a superabundance of details, it gives just the current topics of physical science needed by every one who claims to have received a liberal education.

HIGH-TENSION POWER TRANSMISSION. A series of papers and discussions presented at the meetings of the American Institute of Electrical Engineers. New York: McGraw Publishing Company. 466 pages. Price, $3.00.

In the year 1902 a Transmission Committee of the American Institute of Electrical Engineers was appointed for the purpose of collecting data respecting present practice in electric transmission at high voltage and of presenting a report to indicate the successful methods in operation in such a form as to be of immediate value to electrical engineers.

The Transmission Committee adopted two methods of procedure. One of these was to send to the various transmission plants in the United States a printed list of questions relating to high-tension transmission, with a request that answers to the questions be filled in and the lists returned. The other method was that of instituting discussions on chosen topics which would bring forth from the engineers taking part in these discussions information in regard to the work in question, which could not otherwise be obtained.

The permanent value of the information brought out through the work of the committee justifies fully the collection of the matter in book form. The papers and discussions have been taken directly from the *Transactions* of the Institute, with such minor changes as were necessary for co-ordinating the different parts. The book contains 23 separate papers by 18 different authors prominent in transmission work. All features of the subject are treated exhaustively, differences of opinion of the various engineers being brought out in the discussions, which are given in full. A valuable part of the volume resides in the collection of data upon line construction, insulators, pins and the like, and the conditions of operation at different voltages and under different climatic conditions. These data relate to present practice in America. The placing of this information in compact and convenient form for reference should prove a valuable addition to engineering literature.

General Electric at the Portland Exposition.

The General Electric Company had a fine exhibit at the Lewis and Clark Exposition, as indicated by the view here shown in Machinery Hall, Fig. 1. This exposition in common with all other recent American shows on a scale of national importance was lighted by Edison incandescent lamps, furnished by the company. A unique

FIG. 1.—GENERAL ELECTRIC EXHIBIT.

feature was the extended use of Meridian lamps, some idea of the effect of which can be obtained from Fig. 2.

Announcement is now made that the Superior Jury at the Lewis and Clark Exposition has approved the following awards in the electrical department, relating to exhibits of the General Electric Company, which was the largest manufacturer exhibiting in that department. The highest award granted by the jury is a gold medal. The company received a gold medal for the best exhibit in the electrical department and also gold medals on each of the following features of this exhibit: (1) Curtis steam turbine, (2) meters and instruments, (3) time-limit relays and oil switches, (4) switchboards, motor-controlling panels; (5) circuit-breakers and lightning

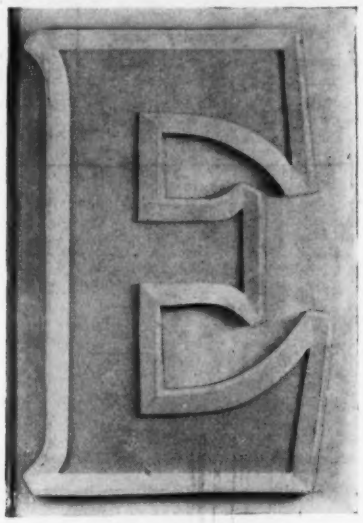
FIG. 2.—NIGHT ILLUMINATION.

arresters, (6) direct and alternating-current motors, (7) direct and alternating-current generators, (8) static transformers, (9) automatic voltage regulators, (10) magnetite arc lamp, (11) alternating and direct-current enclosed arc lamps, (12) mercury arc lamps, (13) magnetic starting device for mercury arc lamps, (14) mercury arc rectifier, (15) railway motors and controllers, (16) mining locomotives, (17) searchlight and method of control, (18) progress and development in the art. For its new metallized carbon filament incandescent lamps the company also received a gold medal.

Day-and-Night Electric Signs.

The accompanying illustration shows a novel and attractive electric sign which possesses numerous features worthy of mention. The letters which serve to form the sign are mounted on zinc sheets which are interlocking, i. e., each sheet locks into the ones immediately preceding and following it; then the joints are hammered down flat, and the zinc background of the letters is coated with smalt (the sand-like mixture used by sign makers); and the joints are then invisible. This interlocking arrangement makes it very easy for the central station man or local sign maker to build up the signs from the letters kept in stock or obtained on special order.

The most interesting and characteristic feature of the sign is the translucent fabric built on a woven-wire foundation of which the letter proper is made. This fabric so distributes the light received from incandescent lamps arranged behind the sign that it is uniformly diffused over the whole letter, instead of being brilliant directly in front of the lamp and darker in other places. It is claimed that this sign is more economical to build and operate than a bulb



INTERLOCKING LETTER.

sign, and that the letters are distinct at a greater distance than is the case where the letters are built of lamps.

The translucent substance is outlined by a raised and gilded carving, the combination making a beautiful and indestructible letter. In the day time these letters on a dark background make the sign conspicuous. Nothing about it indicates that it is an electric sign. There are no letters or outside wiring, and it is stated that the appearance of the sign by day is much more attractive than that of the usual business signs. This interesting advertising device is being placed upon the market by the Day-and-Night Sign Company, Easton, Pa.

Automatic Belt-Tightening Idler.

A newly designed automatic belt-tightening attachment for the standard Crocker-Wheeler Form L motor is shown in Fig. 1. It may be used wherever the limited center distances between pulleys

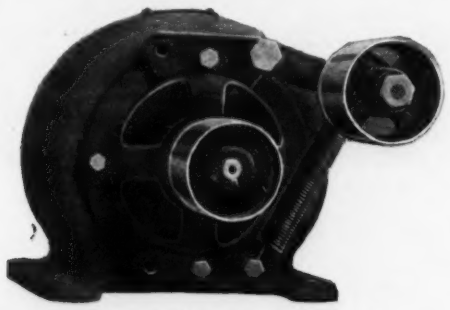


FIG. 1.—BELT-TIGHTENING IDLER.

require an increased belt contact on the pulley surfaces. A good example of the attachment is shown with a Lanston Monotype machine in Fig. 2.

This device is so designed that it may be attached by the customer at any time to any L motor having a rear-end shield. Its principal parts are the idler pulley, arm and block, spring-stud and block and the adjustable spring and hook for connecting them.

The idler pulley and arm are pivoted on a stud which may be screwed into either one of two tapped holes in the block. The block itself may be attached to the motor in any one of four posi-

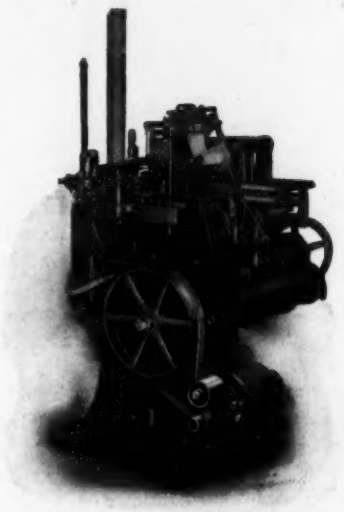


FIG. 2.—MOTOR WITH BELT-TIGHTENING IDLER ON MONOTYPE MACHINE.

tions by a special screw replacing any one of the four machine screws holding the rear shield to the motor frame. Eight locations are thus afforded for the pivot of the idler arm.

Interior Automatic Exchange Telephones.

The Conn. Tel. & Elec. Co., of Meriden, Conn., has placed upon the market an intercommunicating telephone for interior service with many valuable points of interest to every exchange man. This instrument can be connected to the exchange, and is stated to be absolutely non-interfering. One of the many up-to-date

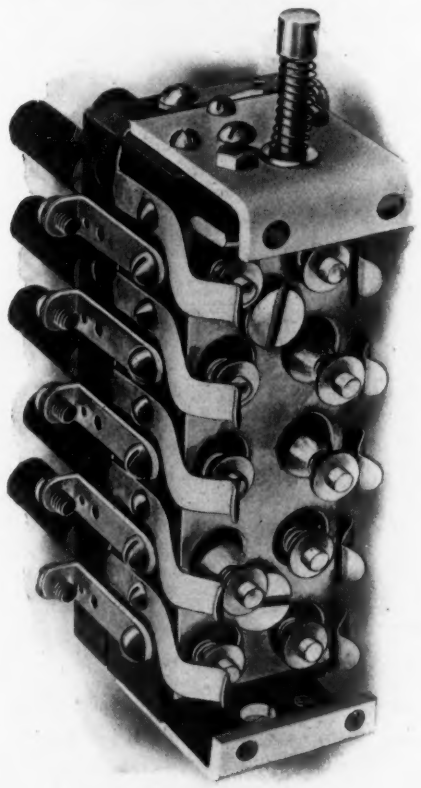


FIG. 1.—MECHANICAL TELEPHONE SWITCH.

features is the new non-interfering exchange trunk button. This device is so arranged that it cuts the telephone from the interior system to the trunk wires so that there is absolutely no chance for interference. With this telephone it is possible to call direct to any point in the system with the receiver on or off the hook. The

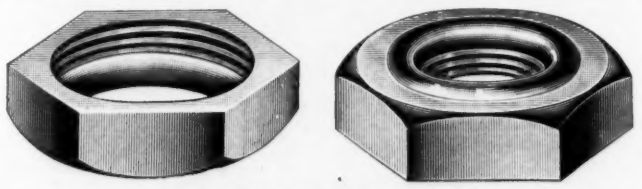
buttons are automatically restored when the receiver is returned to the hook, and the telephone is also cut off the line. It is also possible to call any number of departments together and hold a joint conversation. All connections in these instruments are mounted on hard rubber, and all contacts are rubbing and very positive. The plate of this instrument does not enter into the talking circuit. It is constructed of steel, thereby doing away with the wear and tear of the brass cone and brass plate. With this construction chances for poor mechanical construction are eliminated. It is

FIG. 2.—INTERCOMMUNICATING TELEPHONE.

stated that this telephone is now being adopted by some of the largest exchanges, and it is particularly adapted for common battery exchange service.

The Appleton Conduit Bushing.

A number of schemes have been devised for bushing the ends of iron-armored conduit pipe to prevent the sharp corners of the pipe from cutting the insulation of the wires. The principal problem has been to provide something cheap to manufacture and with a clean thread to receive the end of the pipe. Both these conditions have been ingeniously met in the bushing made by the Appleton Electric Company, of Chicago. This bushing, shown in Figs. 1 and 2, consists of a steel hexagon nut into one end of which is forced a brass



FIGS. 1 AND 2.—CONDUIT BUSHING.

bushing. The process by which this is done is a secret of the manufacturer. The result is a bushing which is practically as solid as if of one piece and at the same time one in which the threads are clean cut clear to the bushing proper. They are made in sizes for from ½ to 3-in. pipe, and a large stock is kept made up. The company has recently started a New York branch at 227 Fulton Street, with A. S. Merrill in charge.

Controller for Variable-Speed Motors.

The accompanying illustration shows the latest Ward Leonard speed controller for variable-speed motors, the speed variation being obtained by changing the field strength. The panel consists of an independent, interlocking overload circuit-breaker and a no-voltage release motor-starter with 20 changes of field resistance. This panel has many special features, as follows:

There is but one lever carrying current for both starting the motor and regulating the speed of the motor.

The rheostat starter and speed-controlling lever cannot be left on any of the starting contacts, but can be left continuously on any of the field resistance contacts; is readily movable in either direction over the field resistance contacts and such movement is entirely independent of the "no-voltage" retractile spring.

The "no-voltage" release protective device is responsive solely to the line voltage and is entirely independent of the field current or the armature current.

The "overload" protective device automatically opens the entire circuit whenever, from any cause and under any conditions a current in excess of that for which the circuit-breaker is adjusted is passed through the rheostat and motor.

MOTOR CONTROLLER.

It is well known to engineers and motor manufacturers that most of the damage that comes to a motor, rheostat or the machine driven is due to excessive current put through the apparatus in starting or attempting to start it. It is stated that the independent interlocking circuit-breaker completely removes this source of danger. The circuit-breaker will always open before the fuses blow. Thus the cost of fuse renewals is saved.

A New Watt-Hour Meter.

The General Electric Company has recently placed on the market a new type of watt-hour meter identical in principle with the earlier forms of the Thomson instrument, but differing widely in structural details.

In general the meter has been made simpler and more compact. The first change in construction to be noted is the method of support. As Fig. 1 shows, the upper lug is key-holed, and the lower right-hand one slotted. This permits rapid and accurate leveling as the screw can be inserted and the meter hung thereon approximately level. The final adjustments can then be made accurately.

The cover is fastened with studs and wing nuts and may be moved directly toward the front, permitting the installation of a large number of meters where space is limited. The sealing wire is passed through the wing nuts and their respective studs necessitating the use of but one wire, and positively prevents tampering without detection. A felt-lined groove surrounds the edge of the cover and the leading-in holes for the wires are covered with the same material, thereby excluding both dust and insects.

In the meter proper a number of improvements have been made. The register is of the four-pointer type, with large clear dials registering directly in kilowatt-hours in all sizes up to 30 kw. Except in the larger sizes no dial constant is necessary. Where a dial constant is required a decimal constant has been chosen, so that the actual energy unit remains the same, and the correct reading is easily obtained by adding ciphers to the dial reading as the constant requires. The lower bearing is made of carefully-selected sapphires, or, in capacities above 50 kw, of diamond. The General Electric Company has recently perfected a method of grinding diamonds in

a concave form and obtaining a polish fully equal to that of the sapphire jewel. The shaft is tipped with a brass pivot fitted with a very finely polished steel point, which, with the jewel cup, forms an ideal bearing surface.

This armature shaft is tubular, thus combining great strength and extreme lightness. On the upper end of the shaft, and very carefully insulated from it, is the commutator (see Fig. 2). This is but one-tenth of an inch in diameter, and with the gravity-controlled brushes, the friction at this point is reduced to a minimum. The gravity-brush control obviates the necessity of a spring adjustment which, even to the most experienced, is a delicate operation.

For protection during shipment and any subsequent transportation the meter is provided with a clamping device which holds the moving element securely in position. This device consists of a brass cap which is normally drawn down and held by the jewel screw against the force of the lifting spring. When drawn down the moving element is free to rotate, but when the jewel screw is backed out the cap is released, and the spring causes it to lift the moving element from the jewel and hold it firmly.

The entire mechanism is assembled upon a skeleton casting which in turn is fastened within the meter casing. By removing four screws and disconnecting the windings from the terminals the mechanism may be removed for inspection and repair.

The plane of the field coils is parallel to the back of the meter, hence by the removal of the front series coil and the register and the loosening of the shunt field coil, the moving element may be taken out. This does not necessitate the removing of the magnets and, therefore, the full-load calibration is unaffected.

An automatic link between the worm wheel and the register permits the removal and replacement of the latter without in any way affecting the proper mesh of the gear and worm.

The four magnets are permanently fastened together in sets of two, and each set may be removed from its supporting shelf by the loosening of two screws.

The armature is spherical in shape and revolves within circular field coils. This construction most nearly fulfills the conditions of lowest possible watt loss with highest torque. The armature is wound with very fine wire, upon a paper shell, and the field windings are of copper ribbon. The damping magnets are subjected to a rigid process of magnetization and ageing to insure absolute permanence.

The value of high torque has become universally recognized as the most essential feature of a motor meter. The peculiar design of the field coils and armature of the Type C meter gives the greatest possible torque combined with mimimum losses and weight of moving element. It is claimed that the torque of this meter is greater than that of any other motor meter in commercial use.

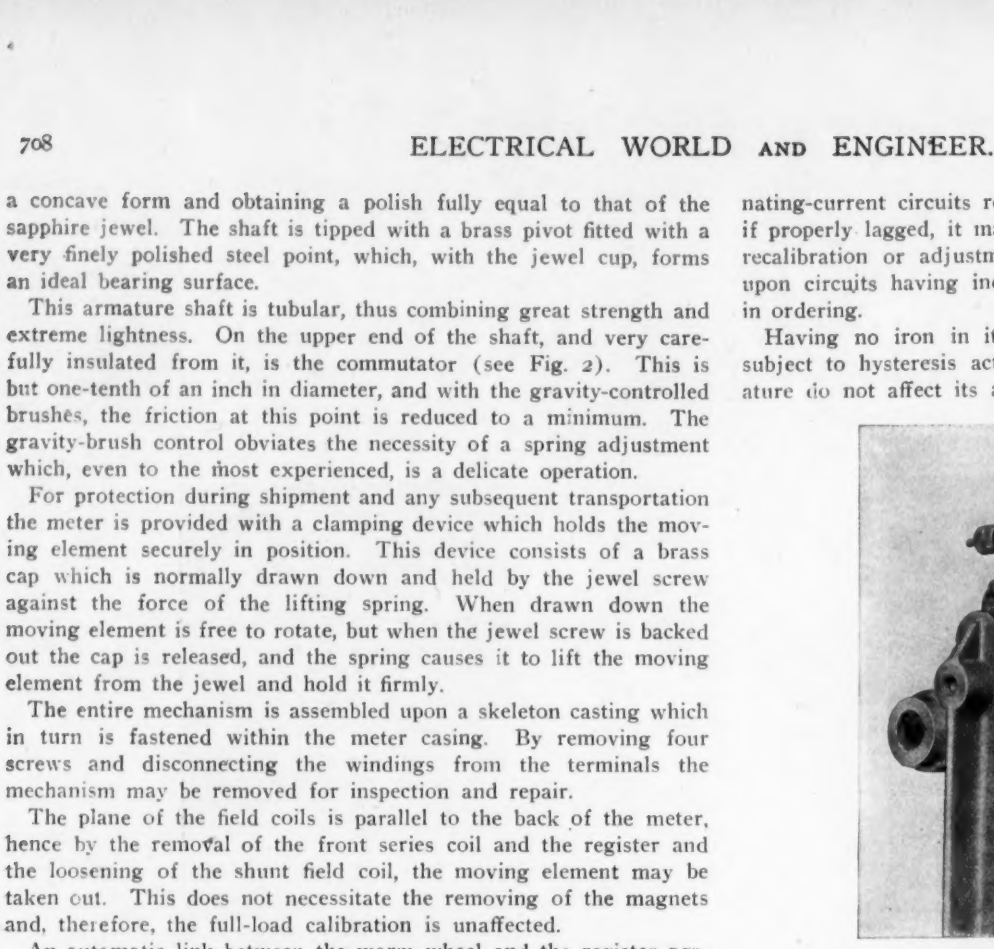


FIG. 1.—PARTS OF WATT-HOUR METER.

The friction torque has been reduced to the lowest possible limits by the use of a small commutator, gravity brushes, and an exceedingly light moving element. The combination of high torque with minimum friction is indicative of the "life with accuracy" that must inevitably result. Although designed primarily for use upon direct-current circuits, the Type C watt-hour meter may, like its immediate predecessor, be used with entire satisfaction on alternating-current circuits regardless of frequency or wave form, and, if properly lagged, it may be used upon inductive circuits without recalibration or adjustment. When meters are required for use upon circuits having inductive loads, the fact should be specified in ordering.

Having no iron in its construction, the Type C meter is not subject to hysteresis action. It is stated that changes in temperature do not affect its accuracy, as the temperature coefficients of both the motor and generator elements are the same, thus compensating for such variations. The liberal rating of this meter and its low losses, permit of operation under a heavy overload for a considerable period of time, without detrimental effects, either permanent or temporary.

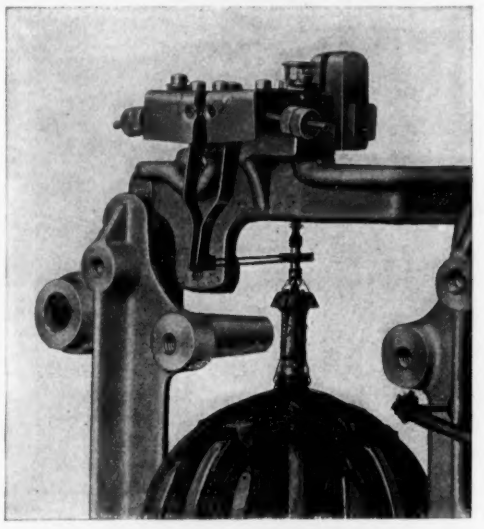
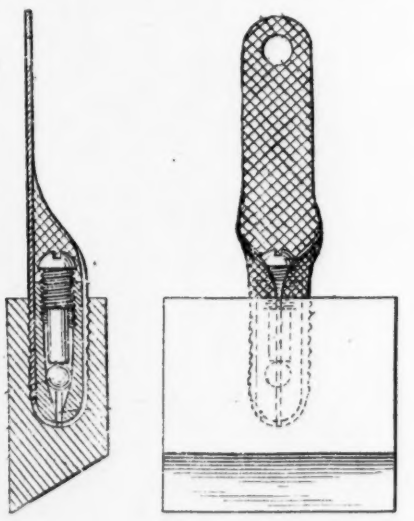


FIG. 2.—INTERIOR OF WATT-HOUR METER, SHOWING SMALL COMMUTATOR AND GRAVITY BRUSHES.

The Type C Thomson watt-hour meter is manufactured in capacities ranging from 5 to 600 amp., inclusive, two wire; and 5 to 300 amp., inclusive, three-wire; and for potentials from 100 to 600 volts.

A New Contact for Carbon Brushes.

One of the most satisfactory forms of contacts for carbon brushes is that in which the brush is equipped with a cap and flexible lead permanently attached to the brush. With this form of contact it is the usual practice to throw away the remains of the brush together with all the fittings, including the cap, flexible lead and terminal. When it is considered that some of the modern large generators require from 200 to 350 brushes per year, and that the loss from the discarded brush fittings are valued at from 10 to 15 cents per brush, it will be appreciated that the yearly loss is considerable.



FIGS. 1 AND 2.—HALLBERG CONTACT FOR CARBON BRUSH.

The accompanying illustrations show a new form of contact with

which it is possible to substitute a new carbon brush in place of the old one without removing the contact wire from the brush holder, thus limiting the loss to the unused portion of the carbon brush and reducing the renewal cost to a minimum.

By reason of the fact that the pigtail is forced against the sides of the cavity in the carbon brush near the point where the current is collected, the loss due to the resistance of the carbon is reduced to a minimum, as has recently been demonstrated by actual tests. The ordinary form of the new contact for standard brushes is shown in Figs. 1 and 2. It has been found in practice that the expander can be operated by a taper screw to very good advantage, especially on the very small machines which require thin brushes, so that it is unnecessary to use the ball expander illustrated. An examination of the cuts show that it is impossible for this contact to work loose. In fact, the more current the brush has to carry, the greater will be the pressure between the sides of the cavity and the pigtail, due to the expansion from heat of the metal expander.

This form of contact is the invention of Mr. J. H. Hallberg, and has recently been placed on the market by the National Carbon Company, Cleveland, Ohio. It is stated that many of them are now in satisfactory service.

Burt "Unit Type" Oil Filter.

The Burt Mfg. Co., Akron, Ohio, has recently brought out a system for filtering oil in which a number of separate units may be connected to filter the oil used in a large plant. Each unit is independent in itself, and new units may be added as the plant grows, thus keeping the capacity of the oil filter system up to the size of the plant.

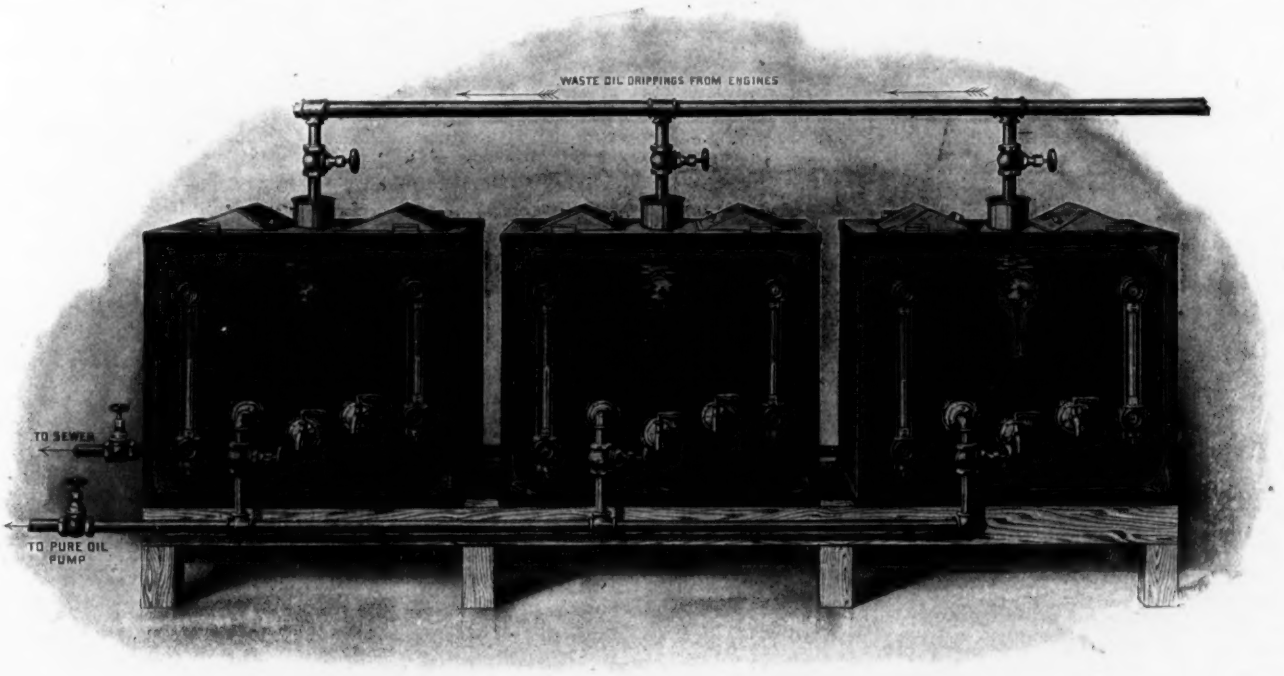
An installation consisting of three units is shown in the accompanying illustration. The dirty oil enters a waste oil receptacle and passes through small perforations, flowing thence horizontally to two filtering cylinders; in passing into these two cylinders the heavy impurities fall by gravity into a sediment pan, being thus finally disposed of and not clogging the filtering cloths or filtering material. The filtering cylinders are wrapped with cloths through which the oil passes before entering the cylinders, and are filled with a quantity of animal bone-black, through which the oil must flow before entering the two tubes which lead from the cylinders to the bottom of the filter. Two plates are attached to the bottom of the tubes by means of which the oil is spread out in a very thin film. It is thus thoroughly washed by the water in the filter and any remaining impurities in the oil drop to the bottom and can be flushed out at any time desired by simply opening the gate valve which connects with the sewer or other waste pipe.

A hot-water chamber surrounds the upper part of the filter containing the filtering mechanism. The water in this chamber is heated by a small steam coil fed with live or exhaust steam from any convenient source. The oil is thus heated before filtering and flows more freely, thereby increasing the speed of filtration and the filter capacity. When heated, the dirty oil spreads out, and most of the dirt and grit then falls into the sediment pan. The bulk of the sediment in this type of filter is at the top, where it can be readily removed without interfering in any way with the supply of pure oil for the oiling system. The filter will handle successfully the heaviest grades of oil, such as lard, gas engine and cylinder oil.

In the construction of the unit type, heavier iron is used than in the regular type of filter, and the body is riveted to a heavy wrought-iron frame. All seams are lapped, riveted and soldered. The upper and lower part of the filter cylinders are made of cast iron, nickel-plated on the top. The tubes leading from the filtering cylinders to the bottom of the filter are of wrought iron. The filter is so constructed that it may be used with or without an oiling system. It can, if desired, be installed and operated at first without being connected with an oiling system, and later on, if an oiling system is added to the plant, pipe connections can readily be made thereto at slight expense.

It is not necessary to shut down a system and disconnect the pipe connections in order to clean the filter. If more than one unit is used it is only necessary to shut off the flow of oil to the filter to be cleaned, the other units being able to handle easily the extra amount. When only one filter is installed, the cloth around one cylinder can be removed instantly; if the filtering material also needs to be removed, one cylinder is unscrewed and a plug furnished for the purpose is screwed into the tube, so as to keep the dirty waste oil from flowing into the filter. The other cylinder continues in operation while the first is being cleaned. Any type of filtering material can be used in the cylinder, such as white waste, sponges, excelsior, raw wool, etc. The manufacturer recommends the use of animal bone-black, which is in use in all oil refineries for purifying oil. This material can be washed with hot water or gasoline and used many times. Filtering cloths may also be used to purify the oil. As any number of cloths may be wrapped around the filtering cylinders, and as in changing them nothing but the cloths need be removed, the latter can be removed while the filter is in operation without changing or touching any pipe connections.

This type of filter is recommended by the makers for use with gas engines of large capacity, as the hot water from the engine cylinders can be used for the purpose of heating the oil. It is also recommended for use with gas or steam turbines, for the reason that an exceptionally large quantity of oil is used on these machines, and the oil being very thin will flow rapidly through this type of filter, owing to the effect of the hot water chamber at the top.



View of a Three-Unit Installation.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade was stimulated generally by the cool weather and jobbing was also helped through the medium of reorders. Much delayed business has also materialized through the lifting or abolition of quarantines throughout the central South. Further strength has likewise developed in iron and steel, which are more firmly held or show further advances. Premiums on quick delivery are now almost universal, and contracts far in 1906 are announced for both crude and finished product. The leading implement concerns have bought freely at the West, with sales of 150,000 tons, one-third of which was taken by the leading harvester manufacturers. Among the other metals copper has eased slightly on less active demand, Lake closing at 16⅜c. Export trade in all kinds of grain and flour shows expansion. Prices of nearly all commodities are strong or tend upward, reflecting insistent demand. The use for money is still growing. The only flaw in the situation is the growing inability of the railroads to handle the freight offered, and the complaint is practically universal. Railway gross earnings in September were very heavy, increasing 6 per cent over the corresponding month last year, while for the nine months of the calendar year the gain over the corresponding period last year reaches 6.4 per cent. Many individual roads show heavy increases. Lumber, hardware and building material are bringing very high prices. *Bradstreet's* reports 183 business failures during the week, against 189 the week previous and 196 the corresponding week last year. The liabilities of commercial insolvencies during the third quarter of the year are reduced.

LARGE ORDERS FOR RONEY STOKERS.—Three orders of large size have recently been received by the Westinghouse Machine Company, of East Pittsburg, Pa., for its Roney mechanical stoker. One order from the Jones & Laughlin Steel Company, of Pittsburg, Pa., calls for sixteen 114 x 24-inch grate stokers; one from the Lehigh Valley Traction Company, of Philadelphia, Pa., calls for eight 130 x 20-inch grate stokers, and another from the Pressed Steel Car Company, of Pittsburg, Pa., covers six 100 x 20-inch grate mechanical stokers. These stokers are of the inclined rocking grate type with removable fuel plates, and are provided with the actuating mechanism for automatically controlling the motion of the grate bars and the supply of fuel. They will be capable of burning low grade bituminous coal efficiently and without smoke. In addition to these orders, smaller ones have been received from the Brown Shoe Company, of St. Louis, Mo.; the Water, Light & Gas Company, of Hutchinson, Kan.; William Wanton Dunnell, of Aponaug, R. I.; Pennsylvania State College, State College, Pa.; Pennsylvania Heat & Power Company, Wilkinsburg, Pa.; Merchants' Light, Heat & Power Company, Canton, O.; Schlitz Brewing Company, Milwaukee, Wis., and the United Shoe Machinery Company, Beverly, Mass.

LONG TROLLEY IN MISSOURI.—The St. Louis, Hillsboro & Southern R. R. Company is about to take bids for the equipment, etc., as well as the construction of the line. The road, which will be about 40 miles in length, will run through the foothills of the Ozark Mountains from South St. Louis to Hillsboro, the county seat of Jefferson County, Mo. The company is incorporated for $1,200,000, the bond issue being $1,600,000. It expects to start grading at once. The equipment will consist of steam and water power. The road will be standard gauge, and the company intends to do freight, express and passenger business. Mr. Henry M. Bowen, formerly with H. M. Byllesby & Co., of Chicago, is the general manager, with offices at 415 Locust Street, St. Louis. The financial part is all arranged for. It is the intention to extend the line 168 miles further south than the present terminus, through a rich lead, zinc, coal and timber country.

RECENT STURTEVANT SALES.—Among recent sales of mechanical draft equipment made by the B. F. Sturtevant Co., Boston, Mass., are those for the boiler plant of the Baltimore & Ohio R. R. Company, Chillicothe, Ohio; Chesebrough Manufacturing Company, Perth Amboy, N. J.; Hillside Coal & Iron Company, Mayfield, Pa.; Castle Realty Company, New York City; Diamond Ice Company, Wilmington, Del.; Athens Water Works, Athens, Ohio; St. Paul Gas Light Company, St. Paul, Minn. The Boston Elevated Railway is to replace its present somewhat antiquated design of economizers by large machines of special construction manufactured by the B. F. Sturtevant Co. Two of these will be installed at the central power station on Albany Street and the third at the East Somerville power station.

THE CANADIAN WHITE COMPANY, LIMITED, has been awarded the contract for erecting at Hamilton, Ont., the new head office building for the Federal Life Assurance Company. Messrs. Finley and Spence, of Montreal, are the architects. This building will be an eight-story, modern steel construction, fireproof office building, and will represent the latest type of building of this class. The White Company has the entire contract, and will have the building ready for occupancy not later than August 1, 1906. The company has also been awarded the contract for the construction of the street car sheds for the Montreal Street Railway Company. Messrs. Marchand and Baskell are the architects.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Sonora, Ky.; Minneapolis, Minn.; Moosminsaskhechewan, N. W. T.; Pattersonville, N. Y.; Des Moines, Ia.; Seward, Ill.; Sublette, Ill.; Little Valley, N. Y.; Beloit, Kan.; Milbank, S. D.; Wheeling, W. Va.; Linn Grove, Ind.; Brooten, Minn.; Abbott, Tex.; Vertrees, Ky.; Fayette, Idaho; Hammonton, N. J.; Chenoa, Ill.; Tiskilwa, Ill., and Swedesboro, N. J.

POWER FOR BILLIARD FACTORY.—The Brunswick-Balke-Collender Company, Chicago, one of the largest manufacturers of interior finishings, store and office fittings and billiard tables, is about to build two large plants, involving an expenditure of $700,000, at Muskegon, Mich., and at Long Island City, N. Y. The Muskegon plant will comprise a power house 50 x 100 feet, with 300 hp in boilers and 250 hp in engines, dynamos, motors and other electrical power units. The plant at Muskegon will be used exclusively for the manufacture of billiard tables.

NATIONAL CARBON.—A financial dispatch from Chicago says: The directors of the National Carbon Company will meet in Cleveland about October 20. The regular quarterly dividend of 1¾ per cent on the preferred stock will be declared, but the question of paying another dividend on the common is not decided. The company paid 1½ per cent on the common stock last January, but the surplus left after this payment was small as shown in the last annual statement. There is a strong local opinion that the surplus of the company should be increased.

COAL MINING PLANT.—The Rock Island Coal Company, Hartshome, I. T., is to install the following equipment at its mines: 100-kw electric plant, including engine, 125-hp return tubular boiler and two chain mining machines, at Mine 7, Hartshome; additional 100-kw electric plant, including engine, two 125-hp return tubular boilers, box car loader and conveyor to boiler room, electric locomotive and slope hoist. Mr. Edward H. Coxe is superintendent.

PLANT FOR PITTSBURG TROLLEYS.—Mr. L. E. Safford, manager of the Pittsburg office of Clark Brothers & Company, of Belmont County, N. Y., has an order from the Pittsburg & Allegheny Valley Street Railway Company for two 660 hp gas engines and one 250 hp gas engine, direct-connected to two large electric generators for a large power plant to be erected by the street railway line at Leechburg, Pa.

VENTILATION OF BUILDINGS.—The two most important buildings being erected in the retail districts of New York and Chicago are to be ventilated throughout by American Blower Company apparatus. Eighteen large fans and heaters and tempering coils containing an aggregate of about 60,000 feet of one-inch pipe will be used in equipping the Altman Building in New York and the Marshall Field Building in Chicago.

BIDS FOR FIRE ALARM SYSTEM.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until November 28, to furnish at the Mare Island Navy Yard, Cal., an auxiliary fire alarm system. Blank proposals will be furnished upon application to the navy pay office, San Francisco, or to the Bureau. Address H. T. B. Harris, Paymaster-General, U. S. N.

BIDS FOR REMODELLING PLANT.—Bids will be received until October 24 by the Department of Correction, New York City, for furnishing material and installing a new switchboard and remodelling the electric light plant in the power house on Hart's Island. Address Francis J. Lantry, Commissioner.

MOTORS FOR CHICAGO.—The South Side Elevated has ordered eighty electric motors from the Westinghouse Electric & Manufacturing Company.

AMERICAN LOCOMOTIVE.—Mr. C. A. Coffin, president of the General Electric Company, and E. C. Converse, a director of U. S. Steel and active in the affairs of the Allis-Chalmers Company, have been elected directors of the American Locomotive Company, succeeding Geo. W. Hoadley and W. Seward Webb. Adams, of the Boston News Bureau, says: "A director of the Lake Shore states that in his opinion every steam locomotive at present in use will be in the scrap heap in 1910. This explains in large measure the recent activity in American Locomotive stock. Much of the recent buying has been for the account of General Electric people, and at the next meeting General Electric interests will be elected to the directorate. The importance of the substitution of electricity for steam as a motive power to the copper and steel trades is too tremendous to be appreciated by the ordinary mind. Copper and steel men are as vitally interested as the railroad men. There will be a ready market at good prices for every pound of copper that can be taken from the ground in the next few years, and it is difficult to see what it is to prevent the greatest boom in the steel trade next year that we have ever known."

NEW FACTORY FOR NATIONAL-ACME.—Plans are being prepared and building operations will commence at once on a four-story (with full basement) brick and steel factory addition to the plant of The National-Acme Manufacturing Company, at Cleveland, O. It is hoped to have the building in readiness for occupancy early in 1906. The four-story addition built during the past summer afforded only slight and temporary relief to the crowded condition of all departments, and the present capacity will be more than doubled when the improvements under way have been carried out. The company builds "The Acme Automatic," the only multiple spindle screw machine on the market, and manufactures also the product therefrom. The field for the machines is world-wide, recent orders having been booked for deliveries to Europe, Asia and South America. The demand which has been created both for these machines and their product is well reflected in the rapid and substantial growth of the business. The company maintains branch offices in New York, Boston and Chicago, and is ably represented in Europe by Messrs. Schuchardt & Schutte and Alfred H. Schutte.

STEADY WATER POWER WANTED.—The De Lamar's Copper Refining Company, of Chrome, N. J., is considering the installation of an electrochemical industry in the Middle West, and is looking for a desirable location near some company that has a hydro-electric power plant and can furnish current for the purpose. The location should be somewhere between Kansas City, Chicago and St. Paul. The amount of power required is not over 500 kilowatts, but this would be a steady load 24 hours and 365 days a year. We should be glad if any of our central station or power plant readers who can meet these requirements would communicate with Mr. H. A. Prosser, general manager of the company.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded a contract for the construction of a complete electrical subway system for the Dayton Lighting Company, Dayton, O. This plant has recently been acquired by new interests, who are rebuilding and re-equipping the entire plant. The contract given to Mr. Gest is for subway installation for the whole city, covering 20 miles of streets, and involving over one million feet of conduit. The system is to be modern and up-to-date, the amount involved being in the neighborhood of $250,000.

ADDITIONAL EQUIPMENT FOR IRRIGATION PLANT in Guanica, Porto Rico, consisting of a 320-hp Fitchburg engine, 250-kw 6,600-volt General Electric generator, transformer, motors, rotary converter and switchboard, and Walker Electric Company panel boards have been purchased by the Guanica Centrale, 44 Wall Street, for addition to its large high-tension electric transmission plant installed in 1902 by Percival Robert Moses, consulting engineer, 320-322 Fifth Avenue, New York City.

PRICES OF STEEL SHAFTING.—Representatives of concerns manufacturing steel shafting met last week and made no change in the present schedule of prices. The members reported that the demand for shafting and other machinery is very active.

THE IDEAL STOKER, 114 Liberty Street, New York, has secured a contract for the installation of Ideal stokers at the Bayonne, N. J., works of the Para Recovery Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was quiet and dull, speculative interests having apparently regarded the warnings of leading bankers against maintaining a bull market in the face of narrow money conditions. Despite the continuance of high interest rates the money market showed a slightly better tone. There was some manipulative activity, particularly in industrial specialties, but the share market tended to settle lower. Considerable attention was paid to the traction group, the unfavorable annual report of the Metropolitan Street Railway system having apparently been discounted in advance. The United States Steel stocks, in spite of very favorable intimations regarding the current earnings of the corporation, eased off with the general list, but on Friday showed a strong tendency to recover. Common closed on Saturday at 38, which is a net gain of ⅛, and preferred at 104½, a net loss of a like amount. Metropolitan Street Railway dropped to 125, but regained some of the loss and closed at 126, which is ½-point below last week's closing quotation. Interborough Rapid Transit, on the curb market, made a net gain of 3½ points on the week's business, closing at 214. Brooklyn Rapid Transit closed at 72⅛, which was near the highest figure of the week for that stock, and a net advance of ⅞-point. Dullness characterized the electric securities. Allis-Chalmers, both common and preferred, lost a fraction in the net result of the week's trading, the former closing at 17⅝ and the latter at 60⅜. Little business was done in General Electric, which closed at 179½, a net loss of 1 point. Westinghouse is 1½ points lower than our last quotation, the closing price being 168. Western Union remains at almost the usual figure, the last quotation recorded at the close of the week being 93⅛, and Mackay Companies is ½-point less, the closing quotation being 46. The market for outside securities was irregular as to prices, and there was a continued heavy trading in bonds. There was another break in Chicago Subway. The general list was quiet, with some strength in copper shares. Most issues, however, were fractionally changed compared with a week ago. The closing quotations on the Stock Exchange on October 17 are given in the following table:

NEW YORK

	Oct. 11	Oct. 18		Oct. 11	Oct. '18
Allis-Chalmers Co.	17⅜	17⅝	General Electric	180½	179
Allis-Chalmers Co. pfd.	60⅜	59¾	Hudson River Tel.	..	..
American Dist. Tel.	32	33	Interborough Rap. Tran.	213	214¾
American Tel. & Cable	92	92	Mackay Cos.	46⅜*	46
American Tel. & Tel.	138	137	Mackay Cos. pfd.	74⅛	72½
Brooklyn Rapid Transit	71⅞	72¼	Marconi Tel.	..	..
Electric Boat	30	30	Metropolitan St. Ry.	127	125⅝
Electric Boat pfd.	70	70	N. Y. & N. J. Tel.	..	..
Electric Lead Reduction	..	..	Western Union Tel.	93⅝	93
Electric Vehicle	16	15½	Westinghouse com.	167⅛	168
Electric Vehicle pfd.	23	23	Westinghouse pfd.	..	..

BOSTON

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Tel. & Tel	137⅛	137¼	Mass. Elec. Ry. pfd.	57	56
Cumberland Telephone	121	122	Mexican Telephone	1⅞	1¾
Edison Elec. Illum.	249	..	New England Telephone	136	138
General Electric	179	179	Western Tel. & Tel.	14	14
Mass. Elec. Ry.	14	13¾	Western Tel. & Tel. pfd.	95	*95

PHILADELPHIA

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Railways	52⅛	52	Phila. Electric	8⅛	8¾
Elec. Co. of America	11¼	11	Phila. Rapid Trans.	27¾	28⅛
Elec. Storage Battery	82	82	Phila. Traction	..	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
Chicago City Ry.	..	..	National Carbon	61	..
Chicago Edison	160	..	National Carbon pfd.	..	..
Chicago Subway	..	41	Union Traction	..	12¾
Chicago Tel. Co	..	137	Union Traction pfd.	..	..
Metropolitan Elev. com.	..	..			

* Asked.

YADKIN RIVER POWER.—T. W. Stephens & Co. Wall Street, New York City, are offering for public subscription $4,500,000 first mortgage 6 per cent gold bonds of the Whitney Company. The company was formed to build and operate a hydraulic power plant on the Yadkin River in North Carolina. There are some 257 mills within eight miles of the power house. The Whitney Company will supply 50,000 hp. The company is named after Mr. George I. Whitney, of Whitney & Stephenson, Pittsburg. Gross earnings of $630,000 are estimated, and operating expenses $97,000, which with interest on bonds of $270,000, would leave $263,000 surplus.

MISSOURI VALLEY ELECTRIC COMPANY.—Official announcement has been made of the formation of the Missouri Valley Electric Railway with a capitalization authorized of $7,500,000, of which $5,000,000 is to be issued; and $7,500,000 of 5 per cent 30-year bonds, of which $5,000,000 is to be issued. This company will be controlled by Cleveland capital. The new line will run from Kansas City to St. Joseph, with connections into Leavenworth and Atchison. The total length of the line will be sixty-six miles. It is the intention to double-track from Kansas City to Leavenworth, which will make the total length of track ninety-five miles.

MESSRS. TUCKER, ANTHONY & COMPANY have just sold five electric traction properties in the Middle West, four to the United Gas Improvement people and one to Chicago & Alton Railway interests, and have successfully organized, or financed, built and managed twenty-eight different street railway, electric light and power companies in the past ten to twelve years. Of these twenty-eight properties, they have sold all but twelve, and it is a remarkable record that in every case the properties have been sold at a profit to the underwriters and the stockholders.

A JERSEY TROLLEY TUNNEL.—The Hudson Street Railroad Company has filed articles of incorporation in the County Clerk's office at Jersey City. The capital stock is $3,000,000 and the object of the company, as given in the papers, is to construct and operate street railway lines in Hudson County. The names of the persons interested and the directors and officers elected indicate that the company is a consolidation of the Morton and Cortlandt Streets tunnel interests and those allied with them in New York. At a meeting of the stockholders these directors were elected: Pliny Fisk and William M. Barnum, members of the banking house of Harvey Fisk & Sons; Walter G. Oakman, president of the Hudson companies which are building the tunnels; William G. McAdoo, president of the Hudson & Manhattan Railroad Company; Andrew Freedman, director of the Interborough Rapid Transit Company, and David Young, of Newark, a former official of the North Jersey Railroad Company. The directors elected these officers: President, William G. McAdoo; vice-president, Andrew Freedman; secretary, K. B. Conger; treasurer, William C. Kinney. The lines to be built by the company will connect with every town, city and township in Hudson County and will connect with the tunnels at Fifteenth Street and Exchange Place, Jersey City. President McAdoo gave out the following statement about the new company: "The Hudson Street Railroad Company was organized for the purpose of increasing and improving the local transportation facilities throughout the principal cities and towns of Hudson County, with a view to operating these lines in connection with the tunnels now being built under the Hudson River. The new lines are so planned as to tap the tunnels at points back from the water front, so that fast time can be made through the congested business districts in Jersey City and Hoboken, and this, coupled with the fact that the new lines will have superior track construction and most modern equipments, will result in reducing the time between the residential and business districts of New York and New Jersey, to practically one-half of that now required to get across the river."

INDEPENDENT TELEPHONE BONDS.—The United States Independent Telephone Company is putting $17,000,000 of its five per cent thirty-year collateral trust bonds on the market. This company proposes to combine a number of the prominent independent telephone companies of the country, and it also claims to have a franchise which will permit it to do a telephone business in the city of New York. The circular describing the bonds states that the company is capitalized at $50,000,000 and owns control of the New York Independent Telephone Company and the Stromberg-Carlson Telephone Manufacturing Company. It is also stated that 413,030 shares of the company have been issued or are under contract to be issued and that 412,970 of these shares will be deposited under a voting trust agreement for a period of seven years, and after the performance of all existing contracts there will remain 86,970 shares of stock unissued. The collateral trust mortgage is for $25,000,000, and the right to redeem the bonds at $1,150 and accrued interest per $1,000 bond at any interest period is reserved. Messrs. Haskins & Sells, certified public accountants, have made a report under date of September 23, 1905, covering the financial operation of the Stromberg-Carlson Telephone Manufacturing Company, from which it appears that the net earnings of the property for the year ending December 31, 1904, amounted to $864,469.18. It also appears from the report that the net earnings for the first six months of 1905 amount to $467,036.91. Messrs. Haskins & Sells estimate that the net earnings for the year 1905 will be approximately $900,000.

PADUCAH CONSOLIDATION.—The Paducah Light & Traction Company, formed by Stone & Webster, to take over the public untility concerns of Paducah, Ky., as noted last week, has an authorized capital of $2,000,000 five per cent thirty-year bonds, of which $575,000 is issued, $625,000 reserved to retire bonds of subsidiary companies, and $800,000 reserved for future improvements; $1,000,000 five per cent non-cumulative preferred stock, of which $600,000 is issued, and $1,000,000 common stock, all issued. This company will control the entire street railway, commercial electric lighting, gas and steam heating business of Paducah, Ky., which has a population of 28,000 and is a substantial commercial and manufacturing center in western Kentucky, 226 miles from Louisville, and 165 miles from St. Louis. Four divisions of the Illinois Central system have terminals and large shops there. There are 140 manufacturing plants in the city, and the agricultural territory tributary to it is particularly well suited to the growing of tobacco. It is estimated that a wholesale business of $10,000,000 per annum is transacted in the city. The street railway system consists of 12 miles, with adequate power house. The street railway franchise does not expire until 1924, the steam heating franchise in 1922 and the gas franchise in 1916. The financial plan provides for placing approximately $300,000 in the treasury of the company to be expended on improvements and additions. The securities of the company have all been underwritten.

NEW JERSEY TELEPHONE.—At a meeting of the stockholders of the New York & New Jersey Telephone Company on October 25 the proposal to increase the capital stock from $15,000,000 to $50,000,000 will be voted upon. It is certain that only a part of the additional $35,000,000 capital stock authorized will be issued; at the present time only $13,770,100 of the authorized $15,000,000 is outstanding. How much will be issued has not been decided. The reason for the increase is said to be the rapid development in business and the resulting necessity for large additions to the plant. Large stock interests in the company are held by the American Telephone & Telegraph Company and the New York Telephone Company. Charles F. Cutler is chairman of the board of the New York Telephone Company and the New York & New Jersey Telephone Company. The latter is sole licensee of the American Telephone & Telegraph Company for Brooklyn, all of Long Island, Staten Island and ten counties in New Jersey. The statement in the circular issued to stockholders contains the following paragraph: "Should the stockholders act favorably upon the recommendation of the directors it is their purpose to offer the new stock and the unissued stock to shareholders from time to time in proportion to their holdings in such amounts as the requirements of the business may demand." The stock is quoted around 170.

DIVIDENDS.—The Tampa Electric Company has declared a semi-annual dividend of $5 per share, payable November 15, to stockholders of record on November 4. The directors of the Toledo Railways & Light Company have declared the regular semi-annual dividend of 1 per cent on the capital stock of the company. Directors of the Milwaukee Electric Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable October 31. A regular quarterly dividend of 1¼ per cent has been declared on the common stock of the Columbus Railway Company, payable on November 1. The directors of the Michigan State Telephone Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable November 1. The Union Traction Company, of Troy, N. Y., has declared the regular quarterly dividend of 1¼ per cent. A semi-annual dividend of $2.50 has been declared by the Edison Electric Illuminating Company, of Brockton; also a semi-annual dividend of $4 by the Lowell Light Corporation.

A LONG TROLLEY.—The Buffalo & Rochester Traction Company, incorporated at Albany with $3,500,000 capital, has for its purpose the construction of an electric road from Depew to Rochester. The company has obtained control of the Buffalo and Depew road, and will extend this line for 60 miles, taking in Batavia, Leroy, Caledonia and intermediate points. Herbert B. Bissell, a director of the company, says: "This road has nothing to do with the New York Central, and that railroad has no interest in our company whatsoever." Mr. Bissell has been prominent in other trolley and street railway enterprises.

CHICAGO TELEPHONE.—Advices from Chicago say: "Reports that Chicago Telephone will increase its dividend rate are denied by officials. It has extended its business by 19,000 telephones since January 1, and has now in operation 135,494 stations. The present payroll of over 5,000 employees is the largest in the history of the company. The next annual statement will be excellent, but operating expenses will show the effects of the higher cost of copper and all raw materials."

PACIFIC GAS & ELECTRIC COMPANY.—The Pacific Gas & Electric Company, with a capital of $30,000,000, has been incorporated in California. This is the company formed by N. W. Halsey & Co., of New York, to take over the California Gas & Electric Corporation and the San Francisco Gas & Electric Company. The directors include John Martin, Frank G. Dunn, E. J. De Sabla, John A Britton, Cyrus Pierce, George W. Levis and L. Foster Young.

RAILWAY CO. GENERAL for the year ended June 30 shows as follows:

	1905.	1904.	1903.	1902.
Income for year.....	$38,215	$45,901	$75,532	$24,618
Expenses, rentals, taxes, etc.	14,473	7,482	7,445	6,748
Net profits	$23,742	$38,419	$68,087	$17,870
Previous surplus	124,377	85,957	17,870	.....
Total surplus	$148,119	$124,376	$85,957	$17,870

NEW YORK CITY RAILWAY.—The annual report of the New York City Railway shows $20,888,124 gross earnings, but a deficit of $2,796,942. The mileage of track was 494 miles, of which 395 was electric. The company still operated 3,849 horses. The number of passengers carried was 420,225,742, to which should be added 191,693,530 transfers.

BULLOCK INCREASE OF CAPITAL.—The Bullock Electric Manufacturing Company, Norwood, Cincinnati, O., has increased its capital stock from $500,000 to $3,000,000, one-half of it being 6 per cent preferred stock.

General News of the Week

The Telephone.

SAN FRANCISCO, CAL.—The Home Telephone Company, of Alameda County, has won its fight in the Common Council for permission to bid on a telephone franchise in Oakland. Bids will be opened Dec. 4. Among the requirements will be the expenditure of $850,000 during three years after the franchise is granted, and giving a guarantee bond of $100,000, besides furnishing the city 50 free telephones. Another provision is that the city shall have the privilege of buying the plant on the expiration of the franchise. The company is composed of substantially the same persons composing the Home Telephone Company, of San Francisco.

CHICAGO, ILL.—The Chicago Telephone Company's monthly instrument statement shows a gain of 2,024 telephones installed during September.

TAYLORVILLE, ILL.—The Christian County Telephone Company has been organized with a capital of $10,000, by W. W. Taylor and W. B. Adams.

BLOOMINGTON, ILL.—A State association of the sub-licensees of the Central Union Telephone Company has been formed at a meeting at the St. Nicholas Hotel, under the name of the Illinois Sub-License Telephone Company. President, G. W. Schlosser, Gobson City; secretary, A. M. Howell.

CHICAGO, ILL.—The Chicago Telephone Company is completing the laying of its conduit system on the West Side. The work on the underground system will end at the corner of Galena street and Downer Place, where connection with the conduit leading from the exchange on the Island to River street, will be made. The conduits were laid in Galena street as far as Highland avenue, and down South River street and up to Lake street.

FRANKLIN, IND.—Louis Holwegg, president of the New Long-Distance Telephone Company, has purchased the Franklin Telephone Company's property and will make extensive improvements.

MILAN, IND.—The Milan Telephone Company, of Milan, Ripley County, has incorporated, with a capital stock of $1,000. The company will build an exchange and system in Milan and Ripley County.

ANGOLIA, IND.—The Steuben County Electric Telephone Company has increased its capital stock from $5,000 to $50,000, with a view of making improvements and extending lines to supply the demand for telephones.

TERRE HAUTE, IND.—The Citizens Telephone Company of this city has been sold to the Kinloch telephone people of St. Louis. W. P. Igams and Fred. Smith, principal stockholders, are said to have manipulated the deal.

FT. WAYNE, IND.—The Ft. Wayne Home Telephone Company has just issued a new directory which contains the names and numbers of 3,300 subscribers in the city, 236 on country roads and 152 at New Haven. The company now gives service to the farmers in every direction from the city.

PRINCETON, IND.—The Princeton Home Telephone Company has obsorbed the Patoka exchange, with its 700 subscribers, and the Patoka exchange has been done away with. The Princeton Company is moving into a new exchange building where a new switchboard of large capacity has been installed.

EDENSBURG, IND.—The City Council has declined to grant a fifty-year franchise petitioned for by the Citizens' Telephone Company. The fact that the company's franchise has three years yet to run created a suspicion that the company sought an extended franchise with a view of selling to the Bell telephone people—a consummation the Council wished to prevent.

FLAT ROCK, IND.—Adam May is a patron of the Flat Rock Telephone Company. May's house was burned several months ago and at the time he had a telephone in his house. When he obtained other quarters, the telephone was placed there. When he rebuilt his house he notified the company to put in a telephone. The company refused to move the one from his temporary headquarters, and May has asked the Circuit Court for a writ of mandate to compel the company to put him in a telephone.

VINCENNES, IND.—It is not improbable that the Bell Telephone Company may obtain control of the independent lines in Knox County outside of Vincennes, because of the difficulty between the Vincennes Telephone Company and the different lines throughout the county. For some time past the Vincennes Company has been levying a tax of $2 per year for each telephone to talk to Vincennes subscribers, while it refused to be taxed for the privilege of talking with the out-side company's patrons. The Bell Company, learning of this fact, has agreed to put in a free system, and this may result in the independent outside companies withdrawing from the Vincennes Company and becoming associated with the Bell.

INDIANAPOLIS, IND.—Upwards of $4,000,000 have been expended on improvements and extensions by the Independent Companies of Indiana during the present year. Among these improvements may be mentioned the entire rebuilding of the Shelbyville Mutual Telephone Company's plant; the large amount of new cable placed by the Crawfordsville Telephone Company; the extension of lines and installing of 500 new telephones at Columbus; the $15,000 expended at North Vernon, in the improvement and extension of lines; the installing of new circuits by the New Long-Distance Company to Franklin, Greenwood, Veedersburg and as far south as Bedford. The Lafayette Telephone Company is expending $75,000 on improvements, and Kokomo has added over 300 telephones and much new equipment has been installed.

GROVE, IA.—A new telephone line is being put through Grove by a company made up of farmers.

CELMAN, IA.—The Clinton County Telephone Company has been incorporated with $15,000 capital.

KIMBALLTON, IA.—The directors of the Marne & Elk Horn Telephone Company have decided to build several new lines.

MINEOLA, IA.—The Mineola Telephone Company has sold its plant to the Independent Telephone Company, of Council Bluffs.

ELKHART, IA.—The Farmers' Telephone Company, with headquarters at Dallas Center, Ia., will extend its lines by building a line from this city to Maxwell, the work to commence at once.

WATERLOO, IA.—J. R. Stewart has become associated with Messrs. Shoemaker and Parker as owner of the Traer, Reinbeck and Gladbrook Telephone exchanges and the toll lines belonging thereto. Mr. Stewart is president; James H. Shoemaker, of Waterloo, secretary and treasurer; Robt. L. Parker, of Gladbrook, manager. The new company will be known as the United Exchange Company, and is capitalized at $35,000.

IOLA, KAN.—The Missouri & Kansas Telephone Company will rebuild the local plant and convert it into a central energy system.

MATTAPOISETT, MASS.—A local company is to be formed in this town to establish telephone service.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company of this city has increased its capital from $2,000,000 to $3,000,000.

YPSILANTI, MICH.—The Ypsilanti Council has accepted the proposal of the Michigan State Telephone Company to place its wires underground.

BENTON HARBOR, MICH.—The Twin City Telephone Company in this city and the Bell Company in St. Joseph have decided to put their wires in the business portions of these two cities under ground.

MANISTIQUE, MICH.—Through the efforts of business men in Manistique and Escanaba, the Michigan State Telephone Company may be induced to undertake the construction of a long-distance telephone line this fall.

BEARDSLEY, MINN.—The Gopher State Telephone Company has increased its capital stock to $50,000.

HELENA, MONT.—The Rocky Mountain Bell Telephone Company is installing a central energy system here.

MOUNT WASHINGTON, MO.—The Missouri & Kansas Telephone Company will erect a telephone exchange at Mount Washington.

ST. LOUIS, MO.—Negotiations are under way at Detroit with St. Louis men representing the new United States Independent Telephone Company, for the taking over of the Detroit Independent Telephone Company, as a part of the merger of telephone lines in large cities from Kansas City to New York. C. Marquard Forster, president of the Kinlock Telephone Company; Max Koehler and Sam B. Jeffries, of St. Louis, are in Detroit to close the deal. A dispatch from Detroit states that in addition to taking over the old independent plant there, the St. Louisans will construct a large new plant, at a cost of $5,000,000. Among those interested in the deal are said to be, in addition to those named above, Thos. H. Wagner, J. H. August Meyer, Arthur W. Lambert, Henry Koehler, Jr., and at least one Kansas City capitalist, Joseph J. Helm, of the City Home Telephone Company. The company will be incorporated with a capital stock of $2,000,000.

TRENTON, N. J.—The Cream City Telephone & Telegraph Company has been formed with a capital of $125,000, by Norman Malcolm, of Chicago, and W. W. Dennison, of Orange, N. J.

NEW YORK, N. Y.—The West Valley Telephone Company has been formed with a capital of $3,000 by Christian Ehman and William H. Proctor.

LITTLE VALLEY, N. Y.—The Citizens' Telephone Company, of this place, has been incorporated with a capital stock of $30,000. The directors are: S. N. Wheaton, A. E. Darrow and E. E. White, of Little Valley.

TICONDEROGA, N. Y.—The Ticonderoga Home Telephone Company has been incorporated with a capital of $25,000. The directors are J. A. McLaughlin, Putnam; R. N. Clemons, Dresden; D. C. Bascom, Ticonderoga.

PETTISVILLE, O.—Pettisville is soon to have a local telephone exchange as the Mutual Telephone Company has just been organized.

SPRINGTOWN, PA.—A new telephone company has been organized in this city to be known as the Franklin Telephone & Telegraph Company; capital, $500. It was incorporated by H. S. Funk, president, and H. H. Funk, secretary.

TERRELL, TEX.—M. A. Joy, of this city, has made application to the City Council for a franchise to operate a telephone system.

CANADIAN, TEX.—The Stockman Telephone Company has been organized with a capital of $250,000 by George Gerlack and D. N. Young.

WEATHERFORD, TEX.—The Riddall Telephone Exchange, which has been in operation here for the past two years, has been purchased by Charlie Clark and J. R. Thomas.

OGDEN, UTAH.—The Bell Telephone Company will shortly install a new $50,000 switchboard in this city.

SEATTLE, WASH.—The Sunset Telephone Company is to erect two buildings in Seattle to cost between $12,000 and $15,000.. The laying of underground conduits and other work will represent an investmet of at least $25,000.

BELLEVUE, WIS.—The Bellevue Telephone Company has increased its capital stock to $10,000.

MARINETTE, WIS.—The automatic exchange of the Wausau Telephone Company has been put into commission.

Electric Light and Power.

BENSON, ARIZ.—It is proposed to organize a company under the name of Benson Light & Water Company, with a capital of $5,000. Doan Merrill is interested.

CLIFTON, ARIZ.—The two large mining camps of Clifton and Morcenci, Clifton, Arizona, are to have electric power to operate both smelters. The Caledonian Coal Company, Gallup, New Mexico, owners of the smelters, is preparing to undertake the project.

SAN FRANCISCO, CAL.—The Helena Power Transmission Company's reserve steam plant at Butte, Mont., will be supplied with boilers and auxiliaries by Charles C. Moore & Co., of San Francisco. The Westinghouse Electric & Manufacturing Company will construct the generators.

SAN FRANCISCO, CAL.—Charles C. Moore & Co., of San Francisco, have secured a general contract amounting to about $500,000 for the complete plant required by the Tonopah Mining Company, at Tonopah, Nev. A 100-stamp mill is included. A great deal of the machinery, including the hoists, will be operated by electric power.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation is installing one of the three frequency-changers, which are to be located in the new gas-engine reserve plant, near San Francisco. It is the intention to start up the new frequency-changer in November and deliver current to the railways so that the engines can be shut down in the Eleventh and Bryant Street power station, which is being converted into a sub-station.

SAN FRANCISCO, CAL.—The Bellingham Bay Improvement Company has sold to Stone & Webster, of Boston, its water rights, machinery and improvements at Nooksack Falls, Wash. The machinery, including two Westinghouse 1,500-kw, 3-phase generators for the 50-mile transmission to Bellingham, was ordered two years ago and stored at the power site. Stone & Webster, who control the Puget Sound Power Company's 30,000-hp plant at Electron, Wash., will install one of the generating units at Nooksack Falls at once, spending about $200,000 on the transmission. Several additional units will be put in later, the ultimate capacity of the plant being 25,000 horse-power. The Bellingham Bay Improvement Company, which is controlled by D. O. Mills, spent about $150,000 in preliminary work.

MAYO, FLA.—The Town Council has granted Clarence H. Ellis and associates a franchise for the construction of an electric light plant and water works.

COLUMBUS, GA.—The City Council is considering the cost of a municipal electric light plant.

MOUNT VERNON, ILL.—A largely attended meeting was held Oct. 2, to take action on the increased scale of charges made by the Citizens' Gas, Electric and Heating Company, for its utilities, the company having refused to adopt the scale of charges recently made by Ordinance of the City Council, which had come to the rescue of the people. The people will tender the old scale of charges. A committee of citizens has been appointed to represent the public and to defend any suit brought by the company, and public subscriptions will be taken up to pay counsel in case of litigation.

GREENWOOD, IND.—The Citizens' Water & Light Company has been incorporated at Greenwood, Ind., with $25,000 capital stock. The directors are David E. Demott, John W. Henderson and James A. Craig.

WEST TERRE HAUTE, IND.—The Town Trustees have granted the West Terre Haute Light & Power Company a franchise to construct and operate an electric light plant. Claude Erwin is one of the incorporators.

SCOTTSBURG, IND.—Messrs. Smith and Shea have been granted a franchise to construct a combined electric light plant and water works. Bids will be invited for the construction of the plant as soon as plans have been prepared.

MATTHEWS, IND.—The La Ruehe Glass Company is having installed in its factory an electric light plant of 500-light capacity. The work is being done by the Reynolds Electric Company, of Marion. The company is also installing steam pumps and a steam heating plant. Manager Strom says he will produce gas from coal at the factory for less than 12 cents per 1,000 cu. ft., the price paid for natural gas.

HUNTINGTON, IND.—The Huntington Light & Fuel Company is installing two 200-kw, 60-cycle, 2,300-volt General Electric generators and switchboard to replace its 125-cycle, 1,040-volt apparatus. The company will furnish current to the Erie Railroad for light and power in the shops at Huntington. The company has also just closed a contract to supply steam for heating the court house now being erected at Huntington.

CHARLES CITY, IA.—A. L. Dodd, of Charles City, and F. O. Martin, of Floyd, have purchased the electric light plant and intend making improvements to it.

WEBSTER, IA.—Mr. R. B. Leroy, in behalf of outside capitalists, has offered the city of Webster, Ia., $100,000 for the municipal water, heat, light and gas plants and a street car franchise.

FORT DES MOINES, IA.—Bids will be received by L. Hardeman, Quartermaster U. S. A., Fort Des Moines. until Nov. 6 for furnishing and installing electric light fixtures, watt meters, and transformers, and wiring for electric lighting, in the buildings at Fort Des Moines.

LEWISTON, ME.—The Lewiston & Auburn Electric Light Company will make a further reduction in rates to all its customers, upon meter service. The reduction is from 10 cents per kilowatt hour to 9 cents per kilowatt hour.

ELLSWORTH, ME.—The City Council has taken action which will enable a company of which W. H. Buhlen, of Boston, Mass., is the head, to build a dam across Union River. The company proposes furnishing power to the industries of Ellsworth, Bar Harbor and vicinity. The probable cost of the proposed plant is $1,000.000.

SOUTH HANSON, MASS.—A new company will soon be incorporated in this town, known as the Hanson Gas & Electric Compay, with W. E. Damon as president.

SOUTH HADLEY, MASS.—The Holyoke Water Power Company, of Holyoke, has petitioned the selectmen of South Hadley for permission to erect poles and string wires from Holyoke to South Hadley Center.

CADILLAC, MICH.—The Cadillac Water & Light Company has been formed with a capital of $10,000 to $200,000.

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works until Oct. 20 for a direct-connected unit consisting of engine, alternator and appurtenances. Specifications are on file with the secretary Saml. A. Freshney, and will be forwarded on application.

BELLE PLAINE, MINN.—The Council has voted to install a municipal light plant.

LEROY, MINN.—The electric light plant, recently destroyed by fire, will not be rebuilt until spring, but it is stated that a dynamo will be installed in the mill to furnish current in the meantime.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company is preparing plans to place its wires underground in this city.

COLLINSVILLE, MO.—The Collinsville Gas, Electric & Refrigerator Company, of Collinsville, Mo., has been incorporated by Chas. F. Slocum, of Belleville, John H. Seigel and W. E. Hadley, with a capital of $50,000.

CHATHAM, N. B.—This town will apply to the Legislature for power to issue $35,000 bonds for the construction of an electric light plant.

GRAND ISLAND, NEB.—The Grand Island Electric Company has been incorporated with a capital of $60,000 by Arthur F. Vila, G. H. Payne, Irving F. Baxter and others.

RENO, NEV.—The entire territory north of the Southern Pacific tracks and the town of Sparks has been placed on the distributing system of the old Washoe Power & Development Company, and soon all customers in Reno will be using current from the plant of the old Washoe Company, near Laughton's. As soon as the transfer is made the city of Reno will take its entire current from this plant. The substation of the Reno Company in the western part of the city will be closed down and the Floriston power will be used all together for Carson, Virginia and other towns in that section.

KEENE, N. H.—The stockholders of the Citizens Electric Company of this city have voted to increase the capital stock of the company from $35,000 to $50,000.

ATLANTIC CITY, N. J.—The City Council has granted the Atlantic City & Suburban Electric Company a franchise to supply light, heat and power.

ALBANY, N. Y.—The Tremont Mills Utility Company, of New York, has been incorporated with a capital of $500, to supply electricity for light, heat and power. The directors are: S. K. Jacobs, C. A. Jacobs and E. L. Jacobs, of New York.

ROCHESTER, N. Y.—The purchasing agent has been directed to procure estimates of cost of an electric light plant for the court house. The work has not yet been authorized. W. Gillette is the clerk of the Board of Supervisors.

SYRACUSE, N. Y.—The Syracuse Lighting Company is about to close a contract with the Niagara Falls Power Company for 10,000 horse-power. It is said that this is done for the purpose of forestalling competition. The transmission company, which is now engaged in securing rights of way, has reached as far as Monroe County. By March 1, power from Niagara Falls is expected to be operating the Rapid Transit railway system in Syracuse, where a large sub-station will be built.

OBERLIN, OHIO.—The Oberlin Gas & Electric Company has been taken out of the receivers' hands and refinanced by J. C. Hill, of Elyria; A. E. Hay, of Oberlin, and others. The company will install a heating plant and will make important improvements to the lighting plant.

ROSEBURG, ORE.—The citizens have voted to issue bonds for an electric light plant and water works.

ALBION, PA.—The question of constructing water works and an electric light plant is under consideration here.

ANDERSON, S. C.—Jos. E. Sirrine, of Greenville, has prepared plans for the electric power plant which is to be constructed at Hatton Shoals on Tugalo River, to develop 5,000 horse-power for the Hatton Shoals Company, of which R. S. Ligon, of Anderson, is president.

GAFFNEY, S. C.—The fine water power—Gaston Shoals,—on Broad River, near Gaffney, it is reported, will soon be developed. It was recently sold to John B. Cleveland, of Spartanburg, S. C., and others by the Gaffney Manufacturing Company. Electrical power for several towns will be available.

CHATTANOOGA, TENN.—The contract, together with the $100,000 bond which have been made between the Chattanooga-Tennessee River Power Company and the Goverment for the building of the lock and dam for the power plant on Tennessee River, it is stated, have been approved by the War Department. John Bogart, New York, N. Y., is the consulting engineer.

ORANGE, TEX.—The Orange Ice, Light & Water Company has been incorporated with a capital of $60,000, by Saml. C. Trimble, W. H. Stark and P. B. Curry.

COALVILLE, UTAH.—A power plant of 2,000-hp. capacity is projected in this city by the Intermountain Electric Company, the plant to be auxiliary to those already in operation in the Cottonwoods. The new plant will furnish electrical energy for practically all the towns in Summit County. The company has a capitalization of $1,500,000.

PROVO, UTAH.—The Telluride Power Company contemplates the early establishment of a second electric power plant, to be located at a point on the Duchesne. The plan is to provide electrical energy for mining purposes and also for distribution in Salt Lake, Park City, Mercur, Eureka, Price and Bingham. The company has made application to the state engineer for 61 feet of water in the Duchesne.

MONTPELIER, VT.—The Bolton Falls plant of the Consolidated Light & Power Company is to be doubled next spring. The present capacity is 2,000 horse-power and water turbines and machinery will be put in to make the output about 4,000 horse-power.

TACOMA, WASH.—The Nisqually Power Company has been incorporated with a capital stock of $100,000, by R. L. McCormick, Geo. S. Long and others. The company's saw mill will be operated by electricity.

LA BARCA, MEX.—Francisco Castellanos proposes to establish an electric light and power plant at La Barca.

VERA CRUZ, MEX.—An electric power plant will be installed on the Laguna de Catemaco, State of Vera Cruz, by Juan Simon Rodriguez.

CITY OF MEXICO, MEX.—Ignacio Saldana will install a large electric power plant on the Rio del Salto. He has made application to the federal government for a concession.

CULIACAN, MEX.—Diego Redo will install an electric power plant on the Tamazula River, in the State of Sinaloa. The power will be transmitted to industries and towns of that section.

SAN IGNACIO, MEX.—Jose H. Rico, president of the Guadalupe de los Reyes Mining Company, has made application to the federal government for a concession to install and operate a large electric light and power plant near San Ignacio.

CITY OF MEXICO, MEX.—Luis E. Reyes, of the City of Mexico, will establish an electric power plant in the State of San Luis Potosi, at a waterfall on the Los Naranjos River. The electric power will be transmitted a considerable distance.

CORDOVA, MEX.—George G. Bergman, of the City of Mexico, has applied to the federal government for a concession to install a large electric power plant on the Blanco River, near Cordova. The electric current will be transmitted to towns and industrial centers in that region.

GUADALAJARA, MEX.—Compania Industrial de Guadalajara, which operates two electric power plants situated on the Santiago River, near Guadalajara, will compete with La Electra Company for business of furnishing electric lights and power in Guadalajara. It is stated that its plants will be enlarged and other extensive improvements made.

MERIDA, MEX.—The Merida Electric Light Company and the City Council are involved in a dispute over the delay by the company in placing its wires underground. The Council has informed the company that if it does not fulfill its obligations in the matter within six months the Council will proceed to bury the wires and charge the work to the company. Furthermore the company will be fined for its delay.

VERA CRUZ, MEX.—H. B. Tanner, of Indianapolis, Ind., and associates have purchased 30,000 acres of land in the State of Vera Cruz, which they will cultivate in sugar cane. Contracts have been awarded for machinery for a 500-ton sugar refining plant, to be operated by electricity, developed from water power. From 5,000 to 10,000 horse-power will be developed and about $400,000 expended for mill and power plant.

MONTREAL, QUE.—A by-law is before the City Council requiring that all overhead electric wires in the city be put underground.

The Electric Railway.

BIRMINGHAM, ALA.—The city of Bessemer is about to grant a franchise to the Birmingham Railway, Light & Power Company to continue its electric car lines to the town of Jonesboro, five miles beyond Bessemer. The line will then be 23 miles in length.

WASHINGTON, D. C.—A. H. Semms, of Washington, will apply to Congress at its next session for a charter for a new electric railway in the District of Columbia. The proposed road will run through the city and northeastern suburbs, and will be about 12 miles in length.

DOVER, DEL.—All the rights, privileges and appurtenances belonging to the Delaware Electric Traction Company, incorporated here some years ago with the intention of constructing an electric railway from Smyrna to Milford, Del., were turned over to new directors who will, within a few days, secure a new certificate of incorporation under the name of the Smyrna, Kent County & Delaware Bay Traction Company. The new board of directors organized by electing U. Gluck, president; Dr. Thomas C. Moore, secretary; Alfred Tilghman, treasurer. As soon as the preliminaries are completed, a certificate of incorporation will be filed with the Secretary of State, which will give the new company power to begin the construction of the road.

LA SALLE, ILL.—The Illinois Valley Railway Company is building 7 miles of line from Marscilles to Seneca, and is surveying and expects to construct 15 miles next spring in a westerly direction to Princeton.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has decided to extend its line from Robison Park to Garrett and Auburn.

INDIANAPOLIS, IND.—The Indianapolis Union Railway Company has approved plans for a heating and lighting plant for the union station, to cost about $75,000.

BROOKVILLE, IND.—The Richmond, Brookville & Cincinnati Traction Company has secured nearly all of the right-of-way through Franklin County and is now asking for a franchise in this city.

INDIANAPOLIS, IND.—The "Electric Cycle Line" is the name of an electric railway being promoted by J. N. Crabb and others to encircle Indianapolis. It is stated that a company is being formed to build the road.

COLUMBUS, IND.—Owing to the contention arising among farmers on either side of White River, it is thought possible that two interurban roads may be built in making the Seymour extension of the Louisville & Indianapolis line.

INDIANAPOLIS, IND.—The Keystone Construction Comapny, of Philadelphia, has acquired and taken over from George W. Townsend the contract for the construction of the Indianapolis & Western Electric Railway's line, between Indianapolis and Brazil.

WABASH, IND.—The Fort Wayne & Wabash Valley Traction Company, operating 80 miles of interurban road, has sent to farmers along the line an offer to furnish power to run the machinery on farms. The company proposes to furnish motors and build a line for a distance of one mile on each side of the track at cost, if farmers will agree to pay a reasonable sum per year for the power.

DALTON, MASS.—The Pittsfield Street Railway Company is negotiating with the Cranes of Dalton with a view of securing power with which to operate the line to the paper town. Messrs. Crane are constructing a fine new power plant which will be of great service to different enterprises in this region.

NORTHAMPTON, MASS.—A plan is being considered for building an electric railway through the Berkshires to this city and possibly to points farther east, so as to connect the eastern part of the State of New York, with the western section of Massachusetts. It is proposed to build the new system under an old charter which dated back to 1874, and which granted the Boston, Hoosac Tunnel & Albany Railroad rights to construct a road in this section. One of the projectors of the enterprise is J. F. Lape, of Renssalaer, N. Y.

SAULT STE. MARIE, MICH.—The Sault Ste. Marie & Les Chenaux Interurban Railway Company has been organized for the purpose of building an electric railway from Sault Ste. Marie to Cedarville, a distance of about 35 miles, and at that point it is expected that a connection will be made with a boat line running to the Les Chenau Islands and a connection with the Detroit & Mackinac Railway at Cheboygan. The company has not yet been incorporated. Hon. C. H. Chapman, Sault Ste. Marie, is one of those interested.

FLINT, MICH.—The power plant of the Detroit, Flint & Saginaw Railway at Bridgeport has been completed and the road is now operated with its own power, instead of depending on the Saginaw Valley Traction Company for power. The new power plant has a capacity of 500 kilowatts. Two engines, each of 350 horse-power, have been installed, and are direct-connected to generators of 250-kw each. Thece are Fleming tandem-compound engines. There are two boilers equipped to furnish superheated steam. In addition to the machinery already installed reserve space remains for another battery of two boilers and another engine.

DETROIT, MICH.—The Detroit-Bay City Traction Company has filed a trust mortgage for $3,000,000 to the Ross Construction Company, of Chicago, to cover a bond issue of that amount and has let a contract for the construction of the road, which will extend from Detroit to Bay City. A subsidiary company, known as the Wayne Construction Company, of Detroit, has been organized to carry on the work in Michigan. The contract calls for the completion of the road by Oct. 1, 1906. Construction work will begin at Bay City, run east to Akron and thence south to Caro. The entire length of the road will be 112 miles. The power house will probably be located at Lapeer and sub-stations at Pontiac and Caro. The officers of the company are: President, E. H. Whitcomb, Davenport; secretary, L. H. Rothwell, Detroit; treasurer, C. H. Christian, Detroit.

RAVENNA, O.—E. R. Merrell, acting for Cleveland parties, is securing right of way for an electric railway from Ravenna to Alliance, which will be eventually extended to Cleveland.

SANDUSKY, O.—It is reported that the Lake Shore Electric Railway is planning to build a line from Sandusky to either Clyde or Fremont. Another company is planning to build from Fremont to Sandusky.

ENID, OKLA.—The Enid City Council has granted a street railway franchise to Daniel S. Robert, of Baltimore. It is also proposed to connect the neighboring towns with interurban lines.

TYLER, TEX.—John A. Wallace, of Chicago, Ill., is promoting an interurban electric railway between Dallas and Tyler. The road will be about 125 miles long.

HOUSTON, TEX.—D. P. Shepard, of Houston, and associates have been granted a franchise to construct an electric railway over certain roads of the county, adjacent to the city of Houston.

SAN ANTONIO, TEX.—It is announced that sufficient funds have been subscribed by the people of Campbellton, Pleasanton and other places to insure the building of an interurban electric railway from San Antonio to Campbellton, a distance of about 50 miles. W. A. McCoy, of Campbellton, is promoting the enterprise. The road will carry both freight and passengers.

MINERAL WELLS, TEX.—At a meeting of the stockholders of the Fort Worth & Mineral Wells Electric Railway Company, which was organized here recently, the following officers were elected for the ensuing year: President, Cicero Smith; vice-president, D. M. Howard; secretary and treasurer, H. N. Frost; general manager, Albert Stevenson. It was decided to commence surveying a line to Fort Worth at once.

SOUTH BEND, WASH.—J. W. Mackenzie, of Portland, and L. M. Dooly, of Hoquiam, have applied to the City Council for a franchise for a street car line to run from South Bend to Raymond.

VANCOUVER, WASH.—Articles of incorporation of the Vancouver & Suburban Railway Company have been filed. The incorporators are W. H. C. Sugg, John H. Sugg, M. R. Sparks, E. E. Bend, E. M. Green, E. E. Waite and W. S. Wood. The capital stock is fixed at $2,500,000

EL ORO, MEX.—El Oro Mining & Railroad Company has decided to install an electric power plant at a cost of $20,000.

AGUASCALIENTES, MEX.—The stockholders of the Aguascalientes Street Railway Company have ratified the proposition to increase the capital stock to $500,000. The officers elected were: Leon Sigonet, president; John Douglass, vice-president and general manager; Dr. Guadalaupe Ortega, secretary and treasurer.

Obituary.

JOHN I. SABIN.

MR. JOHN I. SABIN.—We noted last week at the moment of going to press the sudden death of Mr. John I. Sabin in San Francisco. It had been mentioned in our pages also a week or two ago that Mr. Sabin, who had not been well for some time, was contemplating a rest of some six months, it being his intention to go to Europe and to indulge in traveling, automobiling, etc. This holiday, however, was not taken soon enough to effect improvement in his health and save his life. Mr. Sabin was born in New York State on October 3, 1847. He entered the United States Army as a telegraph operator in 1864 and from the earliest period was noted as a skillful and talented electrician. The Pacific Coast attracted him as a field for effort, so that he became an operator for the Western Union Telegraph Company, in San Francisco, as far back as 1867. He had already secured advancement and prominence in the telegraphic field when the invention of the Bell telephone changed the course of life for him as it did for so many other young and energetic operators. He took an active part in organizing the pioneer Bell telephone system on the Coast in 1878, and the remarkable development of the telephone in that section of the country was in large measure due to his fertility of resource and combative, progressive spirit. On the death of Mr. Ladd, he succeeded to the presidency. By this time his work had become known far beyond the circles of the Bell telephone system. About five years ago the development of independent telephony in the Middle West had brought about a crisis in the affairs of the Central Union and Chicago Telephone Companies operating under the Bell patents, and it was felt that a strong man was needed to stem the tide and restore the "old line" companies to their former position. Mr. Sabin was selected for this onerous task and somewhat reluctantly moved from San Francisco to Chicago, where, as president of the Chicago Telephone Company from May, 1901, to May, 1903, he rendered brilliant and distinguished service, so that to-day the Bell system in Chicago is one of the first for rate of growth, magnitude and general efficiency. Mr. Sabin's health, however, was affected by the strain, and he does not seem ever to have been the same man since, although the administration of the great network of the Pacific States Telephone Company has shown no signs of weakness or hesitancy at any moment. In fact, it is claimed for it to-day that Mr. Sabin has secured the highest percentage of telephones to population to be found in the whole of the United States. Mr. Sabin was widely known in the electrical field outside of telephony, and was universally liked, there being a great fund of kindliness and good humor beneath the force and strength which enabled him to make so deep a mark on the telephone industry of America during its first quarter century. His loss will be seriously felt by his friends and in the councils of the organization that he served so faithfully and so wisely. Mr. Sabin's direct work is understood to have brought him a large fortune. The funeral was held Oct. 13 under Masonic auspices. The interment was private.

Personal.

R. F. HAYWARD.

MR. R. F. HAYWARD, who has recently accepted the position of general manager of the Mexican Light & Power Company, City of Mexico, was graduated in 1885 from the University College, London, where he received instruction under Professor A. B. W. Kennedy. After graduation he entered the Crompton Works, at Chelmsford, England, where he served an apprenticeship of three years, and was afterwards appointed works superintendent, holding that position until 1894. In this year Mr. Hayward went to Salt Lake City, Utah, to take a position as general manager of the Salt Lake & Ogden Gas & Electric Light Company. In November, 1897, he was appointed electrical engineer of the Union Light & Power Company, its successor. When four four years later this company was consolidated, the new corporation taking the name of the Utah Light & Railway Company, Mr. Hayward accepted the position of electrical engineer and retained this position until September last, when he resigned to take the management of the Mexican Light & Power Company. While with the Salt Lake plant Mr. Hayward interconnected widely-separated hydro-electric and steam power stations and operated them in parallel. A transformer station of 6,000-kw. capacity was erected to receive current from seven water power plants, whence it was transmitted to the city and there distributed for railway, lighting and power service. For a time Mr. Hayward maintained a separate office as consulting engineer in Salt Lake City and during this period his firm, Hayward & Grey, designed and erected the Bear River power plant for the Utah Sugar Company.. He was also consulting electrical engineer for the Pioneer Electric Power Company, of Ogden, and was frequently consulted in connection with many of the large hydro-electric power projects in the Rocky Mountain States. In his new position as general manager of the Mexican Light & Power Company, Mr. Hayward will have direct supervision of nine power stations of the company and its transmission lines and large distributing system. About 100,000 horsepower is at present utilized or being developed from water-power and steam plants, including the large Necaxa station. The power is used for lighting and general power purposes, for the operation of the street railways in the City of Mexico, for pumping the city water, and for mining, while an increasing quantity is being used for heating and cooking service.

MR. R. A. SMITH, of the firm of Osler & Hammond, of Toronto, has been elected a director of the Commercial Cable Company.

MR. FRED. DE LAND is contributing to the Belle Vernon, Pa., *Enterprise* a series of illustrated articles on the evolution of the subscriber's telephone, dating from the opening of the New Haven, Conn., exchange in 1878.

MR. W. JAC. MARLAND has just moved from New York to Chicago to take charge of the Chicago office of the Gould Storage Battery Company. We can imagine no centre of restless activity where Mr. Marland would be more at home than the Metropolis of the West.

MR. E. M. WORDEN, who has been receiver of the electric light plant at Ladysmith, Wis., has given up all connection with the industry, and has gone into the general merchandise business. Mr. A. E. Foster is his successor.

MR. GEO. K. WOODWORTH, for the past four years the examiner in charge of wireless telegraphy and long distance telephony in the Electrical Division of the U. S. Patent Office, is now associated with Alex. P. Brown, Esq., of 31 State Street, Boston, Mass., under the firm name of Brown & Woodworth, attorneys at law. Mr. Woodworth will make a specialty of electrical patent matters in the Patent Office and in the U. S. Courts.

Trade Publications.

GAS AND ELECTRIC PORTABLES.—Catalogue 26 of the Goodwin & Kintz Company, Winsted, Conn., is a profusely illustrated treatise on gas and electric portables, electroliers and newels.

MAGNETO-TELEPHONES.—The Kellogg Switchboard & Supply Company, Chicago, Ill., has recently issued an extremely neat catalogue, designated as bulletin No. 8, dealing with magneto-telephones. Each part which goes to make up a complete telephone set is described in detail and well illustrated, and the function of each is explained at length.

WATTMETER FOR TESTING PURPOSES.—The General Electric Company in bulletin No. 4420 describes the Thomson high-torque induction watt-hour test meter. This meter has been developed to meet a demand for some instrument by means of which tests may be made more quickly than with indicating instruments, and yet at the same time without in the least decreasing their reliability.

ELECTRIC DRILLS.—The Chicago Pneumatic Tool Company, 95 Liberty Street, New York, has just issued special circular No. 52, devoted to air-cooled Duntley electric drills. These drills are constructed along entirely new lines. Each drill is equipped with three small motors within one casing, and is designed for operation from any incandescent lamp socket where the current is of proper voltage.

RAILWAY SWITCHBOARDS.—Bulletin No. 4417 of the General Electric Company treats at great length of generating station and substation switchboards for continuous-current railway systems operated from three-phase generators. In addition to the descriptive and illustrative matter dealing with the switchboards and their component parts, the bulletin contains eleven full-page diagrams of connecting circuits.

HIGH-EFFICIENCY INCANDESCENT LAMPS.—The General Electric Company, Schenectady, N. Y., has just issued bulletin No. 4419, dealing with the new 2.5-watt lamp. These lamps are now offered to the trade in three sizes designed to consume 125, 187 and 250 watts, respectively. It may be of interest to learn that these lamps are listed at a price which corresponds to the equivalent of about 7.5 cents per 16 candle-power.

DIRECT-CURRENT GENERATORS AND MOTORS.—The Northern Electrical Manufacturing Company, Madison, Wis., has issued a comprehensive catalogue, designated as bulletin No. 51, dealing with Northern ring-type generators and motors for power and lighting service. These machines are equipped with detachable pole pieces, which are bolted to a machined field ring. Each detail of the machine is treated at length and well illustrated.

MACHINE OIL.—An exceedingly clever advertising device has just been received from G. E. Hall, 211 Centre Street, New York. A semaphore automatically indicates danger as the cover of a folder, on which is shown a locomotive, is opened, and one is directed to be sure he is right before going ahead. It is pointed out that poor oil is a danger signal, and advantage is taken of the opportunity to explain the good qualities of Hall's mineral machine oil.

THE AMERICAN ARC LAMP COMPANY, of Kalamazoo, Mich., has issued a well-printed catalogue describing its enclosed arc lamps. This company is the successor to the Lea Electric Mfg. Company, formerly of Elwood, Ind. It has taken the old lamp and improved it, and it is claimed that the cost of maintenance has been reduced very materially, in some instances being cut to one-half. The lamps are made for direct-current circuits of 110 or 220 volts. They burn from 150 to 240 hours, depending on the style of lamp. The illustrations show different types of lamps, both standard and miniature, and an alternating current lamp in both sizes, besides some brass and copper covers. At the back of the catalogue are cuts illustrating the mechanism of the lamp, and calling attention to the self-locking switch with which the lamps are equipped. There is also con-

tained within the catalogue an interesting description of the mechanical features of the lamp grouped according to the things spoken of. The catalogue closes with a description of the Ideal arc lamp. It is an admirable publication and is worthy of careful reading by any one interested in the subject of arc lamp lighting.

News of the Trade.

MR. EDWARD E. PIERCE, of Narragansett Pier, R. I., has purchased the construction business formerly conducted by John C. Petteplier, at Daytona, Florida, and will maintain both offices during the business seasons.

OSTHEIMER BROTHERS, Burd Building, 900 Chestnut Street, Philadelphia, are the representatives in the United States of the Wireless Telegraphy Company, Ltd. (Telefunken System) and are placing the apparatus on the market. They welcome inquiries as to apparatus, prices, instruction, etc.

AMERICAN TRANSFORMER COMPANY notes the removal of its factory to 143-153 Miller Street, corner of New Jersey Railroad Avenue, Newark, N. J. This change has been made necessary by the steady growth of its business and the company feel that with the increased space and conveniences acquired in the new building, even better results than in the past can be obtained.

THE SWITCHBOARD EQUIPMENT COMPANY, which recently moved to Bethlehem, Pa., was represented in New York City, last week, by Mr. C. C. Badeau, who came to the city on a business trip. The company has established an office at 39 Cortlandt Street, New York, in charge of Mr. H. M. Badeau, who is prepared to talk about the merits of the circuit breaker which this company makes.

SWISS CLOCKS.—The exhibit being prepared for next December by the Magneta Clock Company of Zurich, Switzerland, is bound to attract much attention not only because of the interest that will naturally be aroused by a Swiss exhibit at the New York Electrical Show, but because of the many interesting features of its electrical time control which will be graphically illustrated by many sectional models.

THE VANDYCK CHURCHILL COMPANY is hard at work preparing its very interesting exhibit for the Madison Square Garden Electrical Show. It will be on hand with a widely assorted line of up-to-date motor-driven machine tools. The interesting part of this exhibit is that the Vandyck Churchill Company will make the exhibit practical by showing all its tools in actual operation with machinists running each tool and turning out the product exactly as it could be seen in an up-to-date machine shop. Needless to say, the tools it will show will be of the very latest design.

THE L. B. ALLEN COMPANY, 1332 Columbia Ave., Chicago, Ill., has experienced so good a business that it has found it necessary to make another increase in its capacity for manufacturing the Allen products. These include a soldering stick, a soldering paste, soldering salts and a commutator compound. The Allen products have been on the market for a long time. They have given so much satisfaction, as evidenced by continued orders from old customers, that the Allen Company has found it rather a consistent thing to increase its quarters at regular periods.

THE NEW YORK TELEPHONE COMPANY is busy perfecting plans to extend the scope of its exhibit at the Madison Square Garden Electrical Show. Beside the huge Bell sign, studded with purple-blue incandescent lights, which will surmount the center space in the Garden, and the model switchboard exhibit, it is now understood that the telephone people will add as a further attraction a line of theatrophones. This feature will possess great novelty to the New York public who have rarely had the opportunity of listening "on tap" to a dozen different plays and operas over the telephones.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, Mr. J. F. Stevens, president, will hereafter be represented in New York by Mr. Arthur Orquan, with headquarters at 114 Liberty Street. This gentleman is well known to the electrical trade in New York, and is familiar with the Keystone apparatus. He is supplied with a complete set of samples and literature, and bids fair to meet with great success in his efforts to sell these instruments. The company is planning for active representation in every large city of the country, and has already arranged to cover several points. It has also in press a new catalogue to supplement, but not to replace No. XII.

MOLONEY ELECTRIC COMPANY, of St. Louis, Mo., well known as successful manufacturer of transformers of all sizes for all classes of electrical work, has appointed the Electro-Dynamic Company, of Hanover Building, 11 Pine Street, New York City, as its Eastern representative. It is believed that this will lead to a large increase of sales of Moloney transformers in this part of the country, as the new agent for it is not only a standard and well-established concern, but has shown remarkable aggressiveness and energy of late years in the introduction of its own specialties, of which the "Interpole" motor is the latest. The Electro-Dynamic Company will welcome inquiries from all users of transformers in its territory.

NEW YORK ELECTRICAL SHOW.—We are asked to announce on behalf of the management of the Madison Square Garden Electrical Show in December that it cannot any longer guarantee reservation of space to intending exhibitors. In explanation of this stand it reports that it has on hand enough applications for reservation to fill the Garden twice over, and in justice to itself and to the exhibitors who have already signed contracts for their space it feels that it is now necessary to establish the rule of "First come, first served." Substantial progress is reported by the managers of the show. During the past week the Electro-Dynamic Company, Magnet Wire Company, Waterbury & Co., Vandyck Churchill & Co., Gold Car Heating Company, all of New York; the Stowe Mfg. Company, of Binghampton, N. Y., and the Magneta Clock Company, of Zurich, Switzerland, have added their names to the already long list of concerns that have signed contracts for space at the Garden.

THE RYDER WIRE & FIBRE MFG. COMPANY, of New York, was recently incorporated with a capital stock of $200,000, to manufacture all kinds of wire and fibrous fabrics, iron steel and copper wire rope and insulated wire. The president and treasurer of the company is G. F. Valentine, who was formerly president and treasurer of the Magnet Wire Company. The fabrics will be manufactured under the patents covering products and machines of H. Ryder, who is vice-president of the company and who was formerly manager of the Ryder Belt & Cordage Company, Buffalo, N. Y. The wire rope the company purposes to produce will be made by a new process by which the torsion is entirely eliminated, and it is claimed that by this method the strength and lasting qualities of the rope is increased about 10 per cent. The materials the company will manufacture will be made of fine wire, about which is spun fibre, and when these fine strands are woven into either a rope or a covering for any material which undergoes a high pressure or hard usage the strength and lasting qualities are doubled. In making such specialties as air brake coupling hose, fire hose, automobile tires, etc., the strength is increased fully 100 per cent. For automobile tires it is especially valuable in that it makes the tire puncture proof and at the same time will stand a very high air pressure and on account of its rough surface will overcome skidding.

EASTERN CARBON WORKS.—The manager of the Eastern Carbon Works, Mr. E. J. Wilson, reports that he is preparing for the Madison Square Garden Electric Show, to be held in New York from December 11 to 23, a complete line of their standard and general forms of carbon work which are now so favorably known in the electrical industry. A special feature of the exhibit will be the Eastern dry batteries, noted for high voltage, amperage, life, uniformity and efficiency, beside possessing exceptional recuperative power. These batteries are made in various forms for telephones, electric bells, annunciators, gas lighting, automobiles, launches, gas engines, and all similar work. The various carbon products of the firm are to be made the medium of a unique display. They include cylinders, porous cup, batteries, plates, discs, boxes, rods, smelting electrodes, brushes and various specialties. Very much in evidence will be the Eastern flash light, a handy little lamp which has earned for itself a reputation in many fields. No up-to-date night watchman would now think of going his rounds without one, and on railroads and in many engineering capacities, employees are finding it equally indispensable. One interesting example of the great value of this carefully and effectively constructed appliance is its use by sportsmen. It is not only an essential part of the outfit of the automobilist, but it is in increasing request by hunters in deep forests and by campers on the mountain and by the seashore.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 10, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,885. ELECTRIC COOKING APPARATUS; Gustav Teuber, Laasphe, Germany. App. filed Apr. 27, 1905. A cooking utensil or kettle having a spiral resistance wire between the inner and outer walls. The inside wall is corrugated to register with the resistance spiral, which gives a larger heating surface.

801,199. PROCESS FOR THE PRODUCTION OF METALS OF THE ALKALI GROUP BY ELECTROLYSIS; Edgar Arthur Ashcroft, Weston, Via Runcorn, England. App. filed Oct. 3, 1903.

801,201. REVERSING SWITCH; Isaac F. Baker, East Orange, N. J. App. filed June 28, 1904. The shaft is spring pressed to a certain angular position, from which it can be moved in either direction. It carries an insulating sleeve upon which are two adjacent spiders which have conductors out of contact with one another, but which overlap so as to occupy a single plane of rotation. The stationary contacts are disposed around the casing within such plane.

801,214. SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed July 2, 1904. The controller cylinder is connected to the handle by a spring and a magnet controlled detent permits movement of the cylinder only at a prescribed rate. A lever on the controller handle can be manipulated to lock the handle and cylinder together when desired.

801,224. AUTOMATIC ELECTRIC MOTOR STARTER; William M. Cumiskey, Newark, N. J. App. filed July 20, 1904. The usual contactors are closed by springs when not opposed by more powerful magnets. The magnets are successively de-energized by a dash-pot controlled switch, the action of which can be arrested at any desired point or contact of its series.

801,225. TROLLEY AND TROLLEY-SUPPORT; Harry P. Davis, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa. App. filed Jan. 3, 1905. (See Current News and Notes.)

801,226. TROLLEY FOR ELECTRIC RAILWAY VEHICLES; Harry P. Davis, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa. App. filed Mar. 6, 1905. (See Current News and Notes.)

801,238. MEANS FOR CONTROLLING CIRCUIT BREAKERS; George H. Hill, Schenectady, N. Y. App. filed Aug. 8, 1904. A form of circuit breaker adapted to be located beneath the car remote from the controller. In addition to the usual overload trip there is another trip operated from the controller and also a resting a resetting magnet.

801,239. CONTROL APPARATUS; George H. Hill, Schenectady, N. Y. App. filed Mar. 1, 1905. Each of the contactors is directly controlled by an air dash-pot which permits the contactor arm to initially move quickly to avoid sparking. The contactor arm must make its full movement, however, in order to close an auxiliary switch which permits the actuation of the next contactor of the series.

801,243. ELECTRIC MEASURING INSTRUMENT; Frank Holden, Rugby,

England. App. filed Jan. 2, 1904. A watt meter for large currents in which the field coils are formed of punched copper plates bolted together to form a multiple circuit across the terminals. The rotary member carrying the shunt coils is hung between the plates.

801,245. ELECTRICAL CONTROLLER; Henry D. James, Pittsburg, Pa. App. filed Feb. 27, 1905. In order to prevent a too rapid actuation of the controller, a solenoid is wound with differential coils, one of which is shunted across the armature terminals and the other across the applied e.m.f. Until the coils neutralize one another, a detent is not released which permits the resistance to be cut out.

801,250. SUPPORTING CLAMP FOR ELECTRIC CONDUCTORS; James R. Kearney, Topeka, Kan. App. filed Dec. 15, 1904. Support for two conductors at a right angle turn. Cross arms are secured to the usual post and carry insulators which respectively support the conductors and guy wires connected thereto.

801,255. ARMATURE CROSS CONNECTION FOR ELECTRICAL MACHINES; Chester B. Mills, Wilmerding, Pa. App. filed Oct. 20, 1904. The cross connections are made at the end remote from the commutator and comprise both spiral and helical strips, each of which accomplishes a part of the angular advance through which the cross-connection must be made.

801,260. BASE CUP FOR INCANDESCENT LAMPS; William D. Packard, Warren, O. App. filed Sept. 14, 1903. In order to adapt very large incandescent lamps to the usual form of socket, a porcelain cup is formed to project from the usual threaded shell, and the lamp is in-set into this cup.

801,261. ELECTRIC LIGHTING SYSTEM; Granville E. Palmer, Boston, Mass. App. filed Nov. 16, 1903. An arrangement for cutting out any desired set of lamps upon the line. At the different distributing stations a cut-out switch is provided which can be thrown from the central station by a special alternating current operating circuit. For this purpose a pawl and ratchet controlled switch is placed at each station which can be stepped into any desired position by successive impulses from the central station.

801,265. CONDUCTOR TERMINAL; Raoul Prugger, Wilkinsburg, Pa. App. filed Jan. 3, 1905. The terminals project in such a way that the castings which are used to connect the terminals with the line can be swung around so as to join both terminals to a single-line wire if desired.

801,285. ELECTRIC CONTROLLER; Robert Wellens, Pittsburg, Pa. App. filed Dec. 19, 1904. The controller has the usual spaced segments, and a continuous ring concentric therewith. The carbon blocks constituting brushes on the controller arm are pressed against both by an equalizing lever.

801,287. MACHINE FOR TAPING COILS; George P. Whittlesey, Washington, D. C. App. filed Apr. 16, 1902. The transformer core is laid horizontally upon a wheel-shaped structure of which the spokes may be made to revolve when desired to turn the core through any angle. The winder occupies a fixed relation between certain spokes.

801,288. QUICK BREAK ELECTRIC SWITCH; Herbert C. Wirt, Schenectady, N. Y. App. filed Mar. 5, 1902. The switch blades are independent of the operating handle and connected thereto by a spring so as to become disengaged from their contacts with a snap after a certain movement of the handle.

801,296. PROCESS FOR THE PRODUCTION OF MOLDED BLOCKS OF SILICON CARBID; Friedrich Bolling, Frankfort-on-the-Main, Bockenheim, Germany. App. filed Mar. 14, 1905.

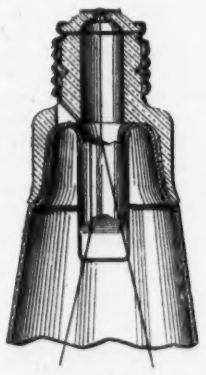
801,308. LOCK FOR AUTOMATIC TELEPHONE-SWITCH SHAFTS; John Erickson, Chicago, Ill. App. filed Dec. 31, 1904.

801,335. TROLLEY; Eugene J. Parker, Providence, R. I. App. filed Dec. 23, 1904. The connection of the harp and pole is made in such a way that the pole is substantially tangential to the front surface of the wheel. The purpose is to deflect guy wires and obstructions from catching upon the wheel. The wheel is also capable of a swiveling movement.

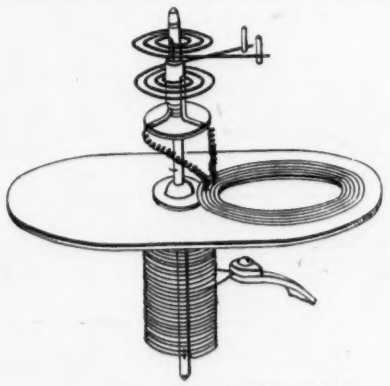
801,355. SELF PROPELLED VEHICLE AND METHOD OF CONTROLLING THE SAME; Ernst J. Berg, Schenectady, N. Y. App. filed Apr. 20, 1904. The vehicle has a gas engine generator which is connected in an unchanging circuit with the motors. For the purpose of regulating the speed of the vehicles the engine speed is alone controlled. For heavy grades and bad roads the motors are thrown into series relation.

801,378. MANUFACTURE OF ARTICLES FROM FUSED MATERIAL; Edward Hart, Easton, Pa. App. filed Dec. 4, 1902.

801,394. SIGNALING; Francis L. O'Bryan, South Framingham, Mass. App. filed June 29, 1905. At each block of the system is a synchronous motor operated by a three-wire system. Each motor has a sliding gear whose position is controlled by a governor, and at a certain speed the gear at



801,260.—Base Cup for Incandescent Lamp.



801,419.—Electric Measuring Instrument.

each block will mesh with the signal operating device. The signalling is done by varying the periodicity of the three-phase current.

801,419. ELECTRIC MEASURING INSTRUMENT; Elihu Thompson, Swampscott, Mass. App. filed Feb. 15, 1905. A watt meter having the usual damping disk with a flat coil thereon which lies wholly within the plane of the disk. The disk rotates in a narrow gap between permanent magnet pole pieces in the usual way.

801,467. ELECTRIC FUSE OR CUT-OUT; Benjamin S. Luther, Boston, and Leonard B. Buchanan, Woburn, Mass. App. filed Mar. 6, 1905. The usual tube or casing has an opening at one side in which is inserted a small charge of gunpowder and a plug. When the fuse blows the plug will be ejected in order to indicate the blow out.

801,487. CONTROLLER; Leonard A. Tirrill, Lynn, Mass. App. filed June 3, 1904. A controller particularly designed for cranes, etc., in which the cylinder has a resistance element wound directly thereon in a spiral form, and its rotation is effective to cut in or out a varying portion of the spiral.

801,489. PROTECTING METAL SURFACES; Friedrich Uthemann, Langfuhr, near Dantzic, Germany. App. filed Oct. 8, 1904. In order to protect the interior of copper tubes from the action of sea water, a network of iron is placed within the tube which itself corrodes away, but is effective to deposit a protecting oxide upon the copper.

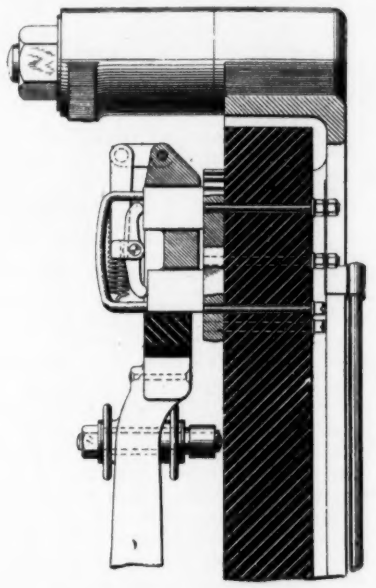
801,494. COVERING FOR CABLES AND SIMILAR DEVICES; Otto Wilhelmi, Kusnacht, Switzerland. App. filed Mar. 31, 1905. A protecting casing formed by weaving metal strips lengthwise through the cloth covering which project at intervals through the cloth in staggered relation.

801,509. SIGNAL SYSTEM; Valentin Chisholm, Rockland, Me. App. filed Apr. 14, 1905. An apparatus to enforce the employee to cross railroad track in front of his car and look out for approaching trains. A gate swings into the path of the approaching car which can only be raised by manipulating a device across the track.

801,532. DEVICE FOR INCREASING THE ADHESION BETWEEN WHEELS AND RAILS; Robert C. Lowry, Seattle, Wash. App. filed Dec. 5, 1904. Electro-magnets are arranged to form complete magnetic circuits through the wheels and a portion of the track.

801,536. FACE PLATE FOR ELECTRIC SWITCHES. Norman Marshall, Newton, Mass. App. filed Jan. 19, 1905. A form of ornamental stock fixture which can be assembled in various ways so as to produce different kinds of switches, according to any specified requirements.

801,543. RAILWAY SIGNAL; Frank P. J. Patenall and George H. Dryden, Baltimore, Md. App. filed May 23, 1905. An opaque disk has a diametrical slot therein through which the light passes from a lamp behind the disk. The danger, caution and safety signals are respectively indicated by the angular position of the slot.



801,285.—Electric Controller.

801,588. TRANSFORMER CUT-OUT; John P. Hetherington, Logansport, Ind. App. filed Dec. 15, 1904. A motor is arranged in such a way as to throw the cut-out switch when the load on the transformer is reduced.

801,589. TRANSFORMER CUT-OUT; John P. Hetherington, Logansport, Ind. App. filed Jan. 4, 1905. A modification of the above in which the motor cuts out a large or small transformer according to the condition of the load.

801,637. ELECTRIC ARC LAMP; Emile Batault, Geneva, Switzerland. App. filed July 19, 1902. The carbons approach one another by gravity until the arc is struck after which they are separated by a small hot air motor which is driven by the current of hot gases from the arc. The motor is locked against rotation when conditions are right, and released when the carbons burn away.

801,718. TROLLEY HARP; Charles L. Hooper, Rochester, N. Y. App. filed Dec. 27, 1904. The harp contains a pair of spring blades which bear against the wheel and make electric connection therewith. Each of the spring blades has an additional tension spring at its extremity.

801,733. AUTOMATIC BLOCK SIGNAL SYSTEM; Ross Logsdon and Eliza S. Stotts, Perry, Ia. App. filed Jan. 18, 1904. The semaphore arms are actuated mechanically by a tappet adjacent to the rails and simultaneously by an electrical trip. They are also restored by mechanical and electrical means.

801,774. CONDUIT FOR ELECTRIC CABLES OR CONDUCTORS; Thomas E. Devonshire, London, England. App. filed Nov. 5, 1904. The successive sections have ends which nest or dovetail together, so as to produce a sealing ring. The sections themselves are formed of expanded metal and concrete.

801,778. TELEPHONE SYSTEM; Charles Edward Egan, Chicago, Ill. App. filed Sept. 26, 1899.

801,779. TELEPHONE SYSTEM AND APPARATUS; Charles E. Egan, Chicago, Ill. App. filed Sept. 29, 1904.

801,780. TELEPHONIC APPARATUS; Charles E. Egan, Chicago, Ill. App. filed Aug. 16, 1905.

801,782. PROCESS OF FORMING NITROGEN COMPOUNDS; Alexander M. Gow, Allegheny, Pa. App. filed Dec. 9, 1902.

801,794. ELECTRIC SIGNAL DEVICE FOR RAILROADS; Ephriam H. B. Knowlton, Superior, Wis. App. filed Apr. 27, 1905. Trolleys are laid adjacent the usual track rails through which a signaling circuit is made to the locomotive cab to indicate the condition of the switches, etc.

801,801. FIELD COIL SUPPORT; Neil MacNeale, Cincinnati, O. App. filed Dec. 7, 1903. The pole pieces flare slightly at their lower ends, but not enough to prevent the coils being slipped thereon. Metal stampings are afterwards placed in such positions as to prevent the withdrawal of the coils.

801,800. SIGNALING THROUGH SUBMARINE AND LIKE CABLES; Oliver Joseph Lodge, Birmingham, and Alexander Muirhead, London, England. App. filed Apr. 25, 1905. (See Current News and Notes.)

801,823. AUTOMOBILE; Ernst J. Berg, Schenectady, N. Y. App. filed May 22, 1905. In an automobile having a gas engine driven generator a primary ignition circuit is made to points on the generator commutator having a less potential difference than the terminal voltage.

12,393. LEADING-IN WIRE FOR INCANDESCENT ELECTRIC LAMPS; Thomas A. Edison, Llewellyn Park, N. J. App. filed July 12, 1905. This is a reissue of a patent issued Jan. 13, 1891, relating to the use of some other metal in connection with platinum for the leading-in wire.